

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

|  |   |  |
|--|---|--|
| Applicant's or agent's file reference<br><b>H623-01</b>  | <b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, Item 5 below. |  |
| International application No.<br><b>PCT/JP 99/ 06743</b> | International filing date (day/month/year)<br><b>01/12/1999</b>   | (Earliest) Priority Date (day/month/year)<br><b>03/12/1998</b> |
| Applicant<br><b>NIPPON SHEET GLASS CO., LTD. et al.</b>  |   |  |

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (see Box II).

### 4. With regard to the title,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

### 5. With regard to the abstract,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

2



None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/JP 99/06743

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 C03B23/033

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 C03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                     | Relevant to claim No. |
|------------|--|-----------------------|
| P, X       | WO 99 24373 A (NIPPON SHEET GLASS CO.LTD.)<br>20 May 1999 (1999-05-20)<br>the whole document           | 1-12                  |
| X          | US 3 545 951 A (NEDELEC)<br>8 December 1970 (1970-12-08)<br>figures 1,2                                | 1-12                  |
| X          | FR 2 137 143 A (SAINT-GOBAIN)<br>29 December 1972 (1972-12-29)<br>the whole document                   | 1-12                  |
| A          | DE 39 28 968 C (VEGLA VEREINIGTE GLASWERKE<br>GMBH) 17 January 1991 (1991-01-17)<br>the whole document | 1-12                  |



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"G" document member of the same patent family

Date of the actual completion of the international search

29 February 2000

Date of mailing of the international search report

07/03/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

Van den Bossche, W

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 99/06743

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---|---------------------|----------------------------|---------------------|
| WO 9924373                                | A | 20-05-1999          | AU 9762298 A               | 31-05-1999          |
| US 3545951                                | A | 08-12-1970          | BE 694790 A                | 28-08-1967          |
|   |   |                     | DE 1679961 A               | 23-03-1972          |
|   |   |                     | FR 92064 E                 |                     |
|   |   |                     | FR 1476785 A               | 26-06-1967          |
|   |   |                     | GB 1134775 A               |                     |
|   |   |                     | LU 53096 A                 | 01-09-1967          |
|   |   |                     | NL 6703042 A,B             | 04-09-1967          |
|   |   |                     | SE 329899 B                | 26-10-1970          |
|   |   |                     | ES 337724 A                | 01-03-1968          |
| FR 2137143                                | A | 29-12-1972          | AR 192445 A                | 21-02-1973          |
|   |   |                     | AU 4229772 A               | 22-11-1973          |
|   |   |                     | BE 783422 A                | 13-11-1972          |
|   |   |                     | CA 973712 A                | 02-09-1975          |
|   |   |                     | DE 2223575 A               | 30-11-1972          |
|   |   |                     | ES 402718 A                | 16-04-1975          |
|   |   |                     | GB 1366038 A               | 04-09-1974          |
|   |   |                     | IT 955515 B                | 29-09-1973          |
|   |   |                     | JP 53041690 B              | 06-11-1978          |
|   |   |                     | LU 65348 A                 | 22-01-1973          |
|   |   |                     | NL 7206307 A,B,            | 16-11-1972          |
|   |   |                     | SE 393593 B                | 16-05-1977          |
|   |   |                     | US 3832153 A               | 27-08-1974          |
|   |   |                     | ZA 7203243 A               | 28-02-1973          |
| DE 3928968                                | C | 17-01-1991          | DE 69004530 D              | 16-12-1993          |
|   |   |                     | DE 69004530 T              | 11-05-1994          |
|   |   |                     | EP 0415826 A               | 06-03-1991          |
|   |   |                     | ES 2048460 T               | 16-03-1994          |
|   |   |                     | FI 91389 B                 | 15-03-1994          |
|   |   |                     | US 5022907 A               | 11-06-1991          |

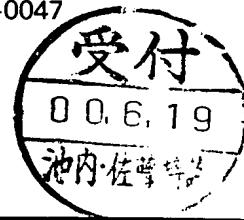
PCT

NOTICE INFORMING THE APPLICANT OF THE  
COMMUNICATION OF THE INTERNATIONAL  
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

IKEUCHI, Hiroyuki  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-shi, Osaka 530-0047  
JAPON

|   |   |                  |
|---|---|------------------|
| Date of mailing (day/month/year)<br>08 June 2000 (08.06.00)   |   |                  |
| Applicant's or agent's file reference<br>H623-01              |   | IMPORTANT NOTICE |
| International application No.<br>PCT/JP99/06743               | International filing date (day/month/year)<br>01 December 1999 (01.12.99) |                  |
| Priority date (day/month/year)<br>03 December 1998 (03.12.98) |   |                  |
| Applicant<br>NIPPON SHEET GLASS CO., LTD. et al               |   |                  |

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:  
AU,CN,JP,KR,MA,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,  
GH,GM,HR,HU,ID,IL,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,  
PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on  
08 June 2000 (08.06.00) under No. WO 00/32527

**REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)**

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a **demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

**REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))**

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

|   |                                    |
|---|------------------------------------|
| The International Bureau of WIPO<br>34, chemin des Colombettes<br>1211 Geneva 20, Switzerland | Authorized officer<br><br>J. Zahra |
| Facsimile No. (41-22) 740.14.35   | Telephone No. (41-22) 338.83.38    |

The demand must be filed directly with the competent International Preliminary Examining Authority, or, if two or more Authorities are competent, with the one chosen by the applicant. All name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ EP

# PCT

## CHAPTER II

### DEMAND

under Article 31 of the Patent Cooperation Treaty:  
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

|   |  |  |
|---|--|--|
| For International Preliminary Examining Authority use only  |  |  |
| Identification of IPEA  |  | Date of receipt of DEMAND  |
| Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION   |  | Applicant's or agent's file reference<br>H623-01                                     |
| International application No.<br>PCT/JP99/06743   | International filing date (day/month/year)<br>01/12/1999 | (Earliest) Priority date (day/month/year)<br>03/12/1998                              |
| Title of invention<br>METHOD AND APPARATUS FOR MANUFACTURING BENT GLASS SHEET   |  |  |
| Box No. II APPLICANT(S)   |  |  |
| Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)<br>NIPPON SHEET GLASS CO., LTD.<br>5-11, Doshomachi 3-chome, Chuo-ku, Osaka-shi<br>Osaka 541-0045 JAPAN                        |  | Telephone No.:<br>03-5443-9514<br>Facsimile No.:<br>03-5443-9567<br>Teleprinter No.: |
| State (that is, country) of nationality:<br>JAPAN   | State (that is, country) of residence:<br>JAPAN          |  |
| Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)<br>YOSHIZAWA Hideo<br>c/o NIPPON SHEET GLASS CO., LTD.<br>5-11, Doshomachi 3-chome, Chuo-ku, Osaka-shi<br>Osaka 541-0045 JAPAN |  |  |
| State (that is, country) of nationality:<br>JAPAN   | State (that is, country) of residence:<br>JAPAN          |  |
| Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)  |  |  |
|   |  |  |
| State (that is, country) of nationality:  | State (that is, country) of residence:                   |  |
| <input type="checkbox"/> Further applicants are indicated on a continuation sheet.  |  |  |

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following person is ☒ agent ☐ common representative  
and ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.  
☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.  
☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

9555 Patent Attorney IKEUCHI Hiroyuki  
7657 Patent Attorney SATO Kimihiro  
10764 Patent Attorney KAMADA Koichi  
11039 Patent Attorney TORAOKA Keiji  
Suite 401, UMEDA PLAZA Building, 3-25  
Nishitenma 4-chome, Kita-ku, Osaka-shi  
Osaka 530-0047 JAPAN

Telephone No.:

06-6361-9334

Facsimile No.:

06-6361-9335

Teleprinter No.:

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments: \*

1. The applicant wishes the international preliminary examination to start on the basis of:

☒ the international application as originally filed

the description ☐ as originally filed  
☐ as amended under Article 34

the claims ☐ as originally filed  
☐ as amended under Article 19 (together with any accompanying statement)  
☐ as amended under Article 34

the drawings ☐ as originally filed  
☐ as amended under Article 34

2. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3. ☐ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

\* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: ..... E n g l i s h .....

- ☒ which is the language in which the international application was filed.  
☐ which is the language of a translation furnished for the purposes of international search.  
☐ which is the language of publication of the international application.  
☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

- |  |   |        |
|--|---|--------|
| 1. translation of international application                              | : | sheets |
| 2. amendments under Article 34   | : | sheets |
| 3. copy (or, where required, translation) of amendments under Article 19 | : | sheets |
| 4. copy (or, where required, translation) of statement under Article 19  | : | sheets |
| 5. letter  | : | sheets |
| 6. other (specify)   | : | sheets |

For International Preliminary Examining Authority use only

received not received

|                          |                          |
|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> |

The demand is also accompanied by the item(s) marked below:

- |  |   |
|--|---|
| 1. <input checked="" type="checkbox"/> fee calculation sheet                             | 4. <input type="checkbox"/> statement explaining lack of signature                                  |
| 2. <input type="checkbox"/> separate signed power of attorney                            | 5. <input type="checkbox"/> nucleotide and or amino acid sequence listing in computer readable form |
| 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: | 6. <input type="checkbox"/> other (specify):  |

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

*Ikeuchi Hiroyuki*  
IKEUCHI Hiroyuki

*Sato Kimihiro*  
SATO Kimihiro

*Kamada Koichi*  
KAMADA Koichi

*Toraoka Keiji*  
TORAOKA Keiji

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply.

☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

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Demand received from IPEA on:

**PCT REQUEST**

H623-01

Original (for **SUBMISSION**) - printed on 30.11.1999 02:09:43 PM

|                |  |   |
|----------------|--|---|
| <b>0</b>       | <b>For receiving Office use only</b>   |   |
| <b>0-1</b>     | International Application No.  |   |
| <b>0-2</b>     | International Filing Date  |   |
| <b>0-3</b>     | Name of receiving Office and "PCT International Application"   |   |
| <b>0-4</b>     | <b>Form - PCT/RO/101 PCT Request</b>   |   |
| <b>0-4-1</b>   | Prepared using   | <b>PCT-EASY Version 2.90<br/>(updated 15.10.1999)</b>   |
| <b>0-5</b>     | <b>Petition</b><br>The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty |   |
| <b>0-6</b>     | <b>Receiving Office (specified by the applicant)</b>   | <b>Japanese Patent Office (RO/JP)</b>   |
| <b>0-7</b>     | <b>Applicant's or agent's file reference</b>   | <b>H623-01</b>  |
| <b>I</b>       | <b>Title of invention</b>  | <b>METHOD AND APPARATUS FOR MANUFACTURING BENT GLASS SHEET</b>  |
| <b>II</b>      | <b>Applicant</b>   |   |
| <b>II-1</b>    | This person is:  | <b>applicant only</b>   |
| <b>II-2</b>    | Applicant for  | <b>all designated States except US</b>  |
| <b>II-4</b>    | Name   | <b>NIPPON SHEET GLASS CO., LTD.</b>   |
| <b>II-5</b>    | Address:   | <b>5-11, Doshomachi 3-chome, Chuo-ku<br/>Osaka-shi, Osaka 541-0045<br/>Japan</b>                                      |
| <b>II-6</b>    | State of nationality   | <b>JP</b>   |
| <b>II-7</b>    | State of residence   | <b>JP</b>   |
| <b>II-8</b>    | Telephone No.  | <b>+81-3-5443-9514</b>  |
| <b>II-9</b>    | Facsimile No.  | <b>+81-3-5443-9567</b>  |
| <b>III-1</b>   | <b>Applicant and/or inventor</b>   |   |
| <b>III-1-1</b> | This person is:  | <b>applicant and inventor</b>   |
| <b>III-1-2</b> | Applicant for  | <b>US only</b>  |
| <b>III-1-4</b> | Name (LAST, First)   | <b>YOSHIZAWA, Hideo</b>   |
| <b>III-1-5</b> | Address:   | <b>c/o NIPPON SHEET GLASS CO., LTD.<br/>5-11, Doshomachi 3-chome, Chuo-ku<br/>Osaka-shi, Osaka 541-0045<br/>Japan</b> |
| <b>III-1-6</b> | State of nationality   | <b>JP</b>   |
| <b>III-1-7</b> | State of residence   | <b>JP</b>   |



## PCT REQUEST

H623-01

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|        |  |  |
|--------|--|--|
| IV-1   | <b>Agent or common representative; or address for correspondence</b><br>The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: | <b>agent</b>   |
| IV-1-1 | Name (LAST, First)   | <b>IKEUCHI, Hiroyuki</b>   |
| IV-1-2 | Address:   | <b>Suite 401, UMEDA PLAZA Building, 3-25,<br/>Nishitenma 4-chome, Kita-ku<br/>Osaka-shi, Osaka 530-0047<br/>Japan</b>  |
| IV-1-3 | Telephone No.  | <b>+81-6-6361-9334</b>   |
| IV-1-4 | Facsimile No.  | <b>+81-6-6361-9335</b>   |
| IV-2   | <b>Additional agent(s)</b>   | <b>additional agent(s) with same address as first named agent</b>  |
| IV-2-1 | Name(s)  | <b>SATO, Kimihiro; KAMADA, Koichi; TORAOKA, Keiji</b>  |
| V      | <b>Designation of States</b>   |  |
| V-1    | Regional Patent<br>(other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)  | <b>AP: GH GM KE LS MW SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT</b><br><b>EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT</b><br><b>EP: AT BE CH&amp;LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT</b><br><b>OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT</b> |
| V-2    | National Patent<br>(other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)  | <b>AE AL AM AT AU AZ BA BB BG BR BY CA</b><br><b>CH&amp;LI CN CR CU CZ DE DK DM EE ES FI GB</b><br><b>GD GE GH GM HR HU ID IL IN IS JP KE KG</b><br><b>KR KZ LC LK LR LS LT LU LV MA MD MG MK</b><br><b>MN MW MX NO NZ PL PT RO RU SD SE SG SI</b><br><b>SK SL TJ TM TR TT TZ UA UG US UZ VN YU</b><br><b>ZA ZW</b>  |

## PCT REQUEST

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|              |   |   |
|--------------|---|---|
| <b>V-5</b>   | <b>Precautionary Designation Statement</b><br>In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. |   |
| <b>V-6</b>   | <b>Exclusion(s) from precautionary designations</b>   | <b>NONE</b>   |
| <b>VI-1</b>  | <b>Priority claim of earlier national application</b>   |   |
| VI-1-1       | Filing date   | <b>03 December 1998 (03.12.1998)</b>                                |
| VI-1-2       | Number  | <b>Patent Application 10-344051</b>                                 |
| VI-1-3       | Country   | <b>JP</b>   |
| <b>VI-2</b>  | <b>Priority document request</b><br>The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):   | <b>VI-1</b>   |
| <b>VII-1</b> | <b>International Searching Authority Chosen</b>   | <b>European Patent Office (EPO) (ISA/EP)</b>                        |
| <b>VIII</b>  | <b>Check list</b>   | number of sheets      electronic file(s) attached                   |
| VIII-1       | Request   | <b>4</b> -  |
| VIII-2       | Description   | <b>22</b> -   |
| VIII-3       | Claims  | <b>3</b> -  |
| VIII-4       | Abstract  | <b>1</b> <b>h623-01abstract.txt</b>                                 |
| VIII-5       | Drawings  | <b>15</b> -   |
| VIII-7       | TOTAL   | <b>45</b>   |
|              | <b>Accompanying items</b>   | paper document(s) attached      electronic file(s) attached         |
| VIII-8       | Fee calculation sheet   | ✓      -  |
| VIII-9       | Separate signed power of attorney   | ✓      -  |
| VIII-16      | PCT-EASY diskette   | - <b>diskette</b>   |
| VIII-17      | Other (specified):  | <b>Revenue stamps of transmittal fee for receiving office</b> -     |
| VIII-17      | Other (specified):  | <b>Submission of certificate of payment for search fee</b> -        |
| VIII-17      | Other (specified):  | <b>Submission of certificate of payment for international fee</b> - |

## PCT REQUEST

H623-01

Original (for SUBMISSION) - printed on 30.11.1999 02:09:43 PM

|         |  |                         |
|---------|--|-------------------------|
| VIII-18 | Figure of the drawings which should accompany the abstract | 10                      |
| VIII-19 | Language of filing of the international application        | English                 |
| IX-1    | Signature of applicant or agent                            | <i>Ikeuchi Hiroyuki</i> |
| IX-1-1  | Name (LAST, First)   | IKEUCHI, Hiroyuki       |
| IX-2    | Signature of applicant or agent                            | <i>Sato Kimihiro</i>    |
| IX-2-1  | Name (LAST, First)   | SATO, Kimihiro          |
| IX-3    | Signature of applicant or agent                            | <i>Kamada Koichi</i>    |
| IX-3-1  | Name (LAST, First)   | KAMADA, Koichi          |
| IX-4    | Signature of applicant or agent                            | <i>Toraoka Keiji</i>    |
| IX-4-1  | Name (LAST, First)   | TORAOKA, Keiji          |

## FOR RECEIVING OFFICE USE ONLY

|        |   |        |
|--------|---|--------|
| 10-1   | Date of actual receipt of the purported international application   |        |
| 10-2   | Drawings:   |        |
| 10-2-1 | Received  |        |
| 10-2-2 | Not received  |        |
| 10-3   | Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application |        |
| 10-4   | Date of timely receipt of the required corrections under PCT Article 11(2)  |        |
| 10-5   | International Searching Authority   | ISA/EP |
| 10-6   | Transmittal of search copy delayed until search fee is paid   |        |

## FOR INTERNATIONAL BUREAU USE ONLY

|      |  |  |
|------|--|--|
| 11-1 | Date of receipt of the record copy by the International Bureau |  |
|------|--|--|

# PCT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY



## PCT

To:

IKEUCHI & SATO PATENT OFFICE  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-Shi  
OSAKA 530  
JAPON

### NOTIFICATION OF RECEIPT OF DEMAND BY COMPETENT INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rules 59.3(e) and 61.1(b), first sentence  
and Administrative Instructions, Section 601(a))

Date of mailing  
(day/month/year) **09. 05. 00** 27. 05. 20

Applicant's or agent's file reference  
**H623-01**

#### IMPORTANT NOTIFICATION

International application No.

**PCT/ JP 99/ 06743**

International filing date (day/month/year)

**01/12/1999**

Priority date (day/month/year)

**03/12/1998**

Applicant

**NIPPON SHEET GLASS CO., LTD. et al.**

1. The applicant is hereby **notified** that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

14/04/2000

2. This date of receipt is:

- ☒ the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
- ☐ the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- ☐ the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. ☐ **ATTENTION:** That date of receipt is **AFTER** the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide*, Volume II.

- ☐ (If applicable) This notification confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

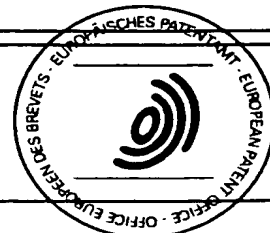
Name and mailing address of the IPEA:

European Patent Office  
D-80298 Munich  
Tel. (+ 49-89) 2399-0, Tx: 523656 epmu d  
Fax: (+ 49-89) 2399-4465

Authorized officer

**BENZLER A**

Tel. (+ 49-89) 2399-8727



# PATENT COOPERATION TREATY

## PCT

### INFORMATION CONCERNING ELECTED OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

From the INTERNATIONAL BUREAU

To:

IKEUCHI, Hiroyuki  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-shi, Osaka 530-0047  
JAPON

|  |  |  |
|--|--|--|
| <b>Date of mailing (day/month/year)</b><br>08 June 2000 (08.06.00) |  |  |
| <b>Applicant's or agent's file reference</b><br>H623-01            |  | <b>IMPORTANT INFORMATION</b>   |
| <b>International application No.</b><br>PCT/JP99/06743             | <b>International filing date (day/month/year)</b><br>01 December 1999 (01.12.99) | <b>Priority date (day/month/year)</b><br>03 December 1998 (03.12.98) |
| <b>Applicant</b><br>NIPPON SHEET GLASS CO., LTD. et al             |  |  |

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

AP : GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW  
 EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE  
 National : AU, BG, BR, CA, CN, CZ, DE, IL, JP, KR, MA, MN, NO, NZ, PL, RO, RU, SE, SK, US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM  
 OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG  
 National : AE, AL, AM, AT, AZ, BA, BB, BY, CH, CR, CU, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IN, IS, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MW, MX, PT, SD, SG, SI, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.

|   |   |
|---|---|
| <b>The International Bureau of WIPO</b><br><b>34, chemin des Colombettes</b><br><b>1211 Geneva 20, Switzerland</b><br><br>Facsimile No. (41-22) 740.14.35 | <b>Authorized officer:</b><br><br><p style="text-align: center;">J. Zahra</p> Telephone No. (41-22) 338.83.38 |
|---|---|

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

|  |  |   |   |
|--|--|---|---|
| Applicant's or agent's file reference<br><b>H623-01</b>  | <b>FOR FURTHER ACTION</b>  |   | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
| International application No.<br><b>PCT/JP99/06743</b>   | International filing date ( <i>day/month/year</i> )<br><b>01/12/1999</b> | Priority date ( <i>day/month/year</i> )<br><b>03/12/1998</b>                        |   |
| International Patent Classification (IPC) or national classification and IPC<br><b>C03B23/033</b>  |  |   |   |
| Applicant<br><b>NIPPON SHEET GLASS CO., LTD. et al.</b>  |  |   |   |
| <p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of      <b>3</b> sheets.</p>   |  |   |   |
| <p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I    <input checked="" type="checkbox"/> Basis of the report</li> <li>II   <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V    <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input checked="" type="checkbox"/> Certain defects in the international application</li> <li>VIII <input checked="" type="checkbox"/> Certain observations on the international application</li> </ul> |  |   |   |
| Date of submission of the demand<br><br><b>14/04/2000</b>  |  | Date of completion of this report<br><br><b>20.10.2000</b>                          |   |
| Name and mailing address of the international preliminary examining authority:<br><br><div style="display: flex; align-items: center;"> <div>             European Patent Office<br/>             D-80298 Munich<br/>             Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br/>             Fax: +49 89 2399 - 4465           </div> </div>  |  | Authorized officer<br><br><b>De Ruiter, F</b><br><br>Telephone No. +49 89 2399 2921 |   |



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/JP99/06743

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-22 as originally filed

**Claims, No.:**

1-12 as received on 05/10/2000 with letter of 02/10/2000

**Drawings, sheets:**

1/15-15/15 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/JP99/06743

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

|                               |      |        |      |
|-------------------------------|------|--------|------|
| Novelty (N)                   | Yes: | Claims | 1-12 |
|                               | No:  | Claims |      |
| Inventive step (IS)           | Yes: | Claims | 1-12 |
|                               | No:  | Claims |      |
| Industrial applicability (IA) | Yes: | Claims | 1-12 |
|                               | No:  | Claims |      |

### 2. Citations and explanations

**see separate sheet**

## VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

## VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

---

International application No. PCT/JP99/06743

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Prior art continuous glass sheet bending methods are extensively discussed in the preamble to the description. These methods have the disadvantages that the glass sheets are marked by the rollers between which they are press bended, that the degree of freedom and the precision of the bend are insufficient and that it is difficult to attain the desired shape at the front and rear end of the sheets, seen in the conveying direction of the sheets. Consequently, the objects of the invention are as specified in the last full paragraph of page 4, which objects are achieved by the method of claim 1 and the apparatus of claim 7 to which there is no lead in the available prior art documents. Especially there is nowhere disclosed or suggested to use a steady upper forming member along which the glass sheets are conveyed with a portion of a belt between the forming member and the glass sheets. Therefore claims 1 and 7 appear to meet the requirements of Articles 33(2), (3) and (4) PCT.
2. As in claims 2 to 6 and 8 to 12 preferred embodiments of the method of claim 1 and the apparatus of claim 7 are defined these claims also appear to meet the requirements of the above articles.

**Re Item VI**

**Certain documents cited**

Certain published documents (Rule 70.10)

| Application No<br>Patent No | Publication date<br>(day/month/year) | Filing date<br>(day/month/year) | Priority date (valid claim)<br>(day/month/year) |
|-----------------------------|--------------------------------------|---------------------------------|---|
| PCT/JP98/05017              | 20.05.1999                           | 06.11.1998                      | 06.11.1997                                      |
|                             |                                      |                                 | 26.11.1997                                      |

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

---

International application No. PCT/JP99/06743

**Re Item VII**

**Certain defects in the international application**

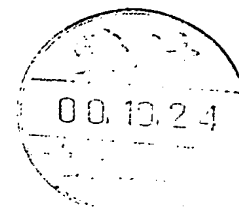
The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**Re Item VIII**

**Certain observations on the international application**

The summary of the invention does not correspond with the independent claims and therefore introduce obscurity into these claims (see the International Preliminary Examination Guidelines, C III, 4.3)

# PATENT COOPERATION TREATY



From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

## PCT

To:

IKEUCHI & SATO PATENT OFFICE  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-Shi  
OSAKA 530  
JAPON

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

|                                     |            |
|-------------------------------------|------------|
| Date of mailing<br>(day/month/year) | 20.10.2000 |
|-------------------------------------|------------|

|  |                               |
|--|-------------------------------|
| Applicant's or agent's file reference<br>H623-01 | <b>IMPORTANT NOTIFICATION</b> |
|--|-------------------------------|

|   |  |  |
|---|--|--|
| International application No.<br>PCT/JP99/06743 | International filing date (day/month/year)<br>01/12/1999 | Priority date (day/month/year)<br>03/12/1998 |
|---|--|--|

|  |
|--|
| Applicant<br>NIPPON SHEET GLASS CO., LTD. et al. |
|--|

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

#### 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

|                                       |                    |
|---------------------------------------|--------------------|
| Name and mailing address of the IPEA/ | Authorized officer |
|---------------------------------------|--------------------|

|   |   |
|---|---|
| <p>European Patent Office<br/>D-80298 Munich<br/>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br/>Fax: +49 89 2399 - 4465</p> | <p>Nilles, F</p> <p>Tel. +49 89 2399-2931</p> |
|---|---|

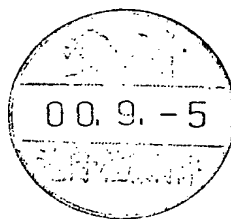


# PATENT COOPERATION TREATY

From the:  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

IKEUCHI & SATO PATENT OFFICE  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-Shi  
OSAKA 530  
JAPON



## PCT

### WRITTEN OPINION

(PCT Rule 66)

Date of mailing  
(day/month/year) 01.09.2000

Applicant's or agent's file reference  
H623-01

**REPLY DUE** **within 3 month(s)**  
from the above date of mailing

International application No.  
PCT/JP99/06743

International filing date (day/month/year)  
01/12/1999

Priority date (day/month/year)  
03/12/1998

International Patent Classification (IPC) or both national classification and IPC  
C03B23/033

Applicant  
NIPPON SHEET GLASS CO., LTD. et al.

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.
2. This opinion contains indications relating to the following items:
  - I ☒ Basis of the opinion
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☐ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain document cited
  - VII ☒ Certain defects in the international application
  - VIII ☒ Certain observations on the international application
3. The applicant is hereby **invited to reply** to this opinion.
 

**When?** See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

**How?** By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

**Also:** For an additional opportunity to submit amendments, see Rule 66.4.  
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis.  
For an informal communication with the examiner, see Rule 66.6.

**If no reply is filed,** the international preliminary examination report will be established on the basis of this opinion.
4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 03/04/2001.

Name and mailing address of the international preliminary examining authority:



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer / Examiner

De Ruiter, F

Formalities officer (incl. extension of time limits)  
Jablanovski, H  
Telephone No. +49 89 2399 2681



**I. Basis of the opinion**

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed".*):

**Description, pages:**

1-22 as originally filed

**Claims, No.:**

1-12 as originally filed

**Drawings, sheets:**

1/15-15/15 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**Certain documents cited**

Certain published documents (Rule 70.10)

| Application No<br>Patent No | Publication date<br>(day/month/year) | Filing date<br>(day/month/year) | Priority date (valid claim)<br>(day/month/year) |
|-----------------------------|--------------------------------------|---------------------------------|---|
| PCT/JP98/05017              | 20.05.1999                           | 06.11.1998                      | 06.11.1997                                      |
|                             |                                      |                                 | 26.11.1997                                      |

**Re Item VII**

**Certain defects in the international application**

1. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**Re Item VIII**

**Certain observations on the international application**

1. It is not clear from the wording of claim 1 that the belt is for a part of it interposed between the glass sheet and the bending surface of the bending member. This appears to be the most essential feature of the invention, as this makes it possible to bend the glass sheet against the bending surface of this bending member without marking the glass upon contact with the bending surface of the bending member. The present wording of claim 1 also covers the possibility that the glass sheet is carried by the belt and, together with the belt, is pressed against the bending surface of the overlaying bending member while being conveyed along this surface by the belt, the glass sheet being positioned between the belt and the bending surface of the bending member, which is certainly not meant by the inventors. For these reasons claim 1 does not meet the requirements of Article 6 PCT (see the PCT International Preliminary Examination Guidelines C III, 4.3 and 4.4).

In order to improve the clarity of claim 7 in this respect it is suggested that the words "having a bending surface" be introduced after the word "member" in line

16 of page 24, that the words "bending surface of the" be introduced before the words "bending member" in line 20 of page 24, and that the words "thereby contacting this bending surface" be introduced after line 20 of page 24.

The suggested wording for claim 7 could be used for meeting the objection for lack of clarity raised against claim 1.

2. For reasons of clarity it is also suggested that the word "from" in line 6 of page 23 be amended into "off", that the word "as" in line 9 of page 23 and in line 13 of page 24 be amended into "while", and that the word "a" in line 11 of page 23 (two times) and in lines 18 and 19 of page 24 (in line 19 only the first "a") be amended into "the".
3. It is also suggested that the expression "toward a downstream conveying side of the glass sheet" in claims 2 and 8 be amended into "in the conveying direction of the glass sheet"

## INTERNATIONAL SEARCH REPORT

International Application No.

JP 99/06743

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 C03B23/033

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 C03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                     | Relevant to claim No. |
|------------|--|-----------------------|
| P, X       | WO 99 24373 A (NIPPON SHEET GLASS CO. LTD.)<br>20 May 1999 (1999-05-20)<br>the whole document          | 1-12                  |
| X          | US 3 545 951 A (NEDELEC)<br>8 December 1970 (1970-12-08)<br>figures 1,2                                | 1-12                  |
| X          | FR 2 137 143 A (SAINT-GOBAIN)<br>29 December 1972 (1972-12-29)<br>the whole document                   | 1-12                  |
| A          | DE 39 28 968 C (VEGLA VEREINIGTE GLASWERKE<br>GMBH) 17 January 1991 (1991-01-17)<br>the whole document | 1-12                  |

☐ Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 February 2000

Date of mailing of the international search report

07/03/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax (+31-70) 340-3018

Authorized officer

Van den Bossche, W



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

/JP 99/06743

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---|---------------------|----------------------------|---------------------|
| WO 9924373                                | A | 20-05-1999          | AU 9762298 A               | 31-05-1999          |
| US 3545951                                | A | 08-12-1970          | BE 694790 A                | 28-08-1967          |
|   |   |                     | DE 1679961 A               | 23-03-1972          |
|   |   |                     | FR 92064 E                 |                     |
|   |   |                     | FR 1476785 A               | 26-06-1967          |
|   |   |                     | GB 1134775 A               |                     |
|   |   |                     | LU 53096 A                 | 01-09-1967          |
|   |   |                     | NL 6703042 A,B             | 04-09-1967          |
|   |   |                     | SE 329899 B                | 26-10-1970          |
|   |   |                     | ES 337724 A                | 01-03-1968          |
| FR 2137143                                | A | 29-12-1972          | AR 192445 A                | 21-02-1973          |
|   |   |                     | AU 4229772 A               | 22-11-1973          |
|   |   |                     | BE 783422 A                | 13-11-1972          |
|   |   |                     | CA 973712 A                | 02-09-1975          |
|   |   |                     | DE 2223575 A               | 30-11-1972          |
|   |   |                     | ES 402718 A                | 16-04-1975          |
|   |   |                     | GB 1366038 A               | 04-09-1974          |
|   |   |                     | IT 955515 B                | 29-09-1973          |
|   |   |                     | JP 53041690 B              | 06-11-1978          |
|   |   |                     | LU 65348 A                 | 22-01-1973          |
|   |   |                     | NL 7206307 A,B,            | 16-11-1972          |
|   |   |                     | SE 393593 B                | 16-05-1977          |
|   |   |                     | US 3832153 A               | 27-08-1974          |
|   |   |                     | ZA 7203243 A               | 28-02-1973          |
| DE 3928968                                | C | 17-01-1991          | DE 69004530 D              | 16-12-1993          |
|   |   |                     | DE 69004530 T              | 11-05-1994          |
|   |   |                     | EP 0415826 A               | 06-03-1991          |
|   |   |                     | ES 2048460 T               | 16-03-1994          |
|   |   |                     | FI 91389 B                 | 15-03-1994          |
|   |   |                     | US 5022907 A               | 11-06-1991          |

# PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

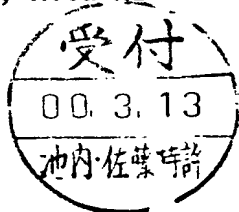
## PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT  
OR THE DECLARATION

(PCT Rule 44.1)

To:

**IKEUCHI & SATO PATENT OFFICE**  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-Shi  
OSAKA 530  
JAPAN



Date of mailing  
(day/month/year)

07/03/2000

Applicant's or agent's file reference  
**H623-01**

**FOR FURTHER ACTION** See paragraphs 1 and 4 below

International application No.  
**PCT/JP 99/ 06743**

International filing date  
(day/month/year) **01/12/1999**

Applicant

**NIPPON SHEET GLASS CO., LTD. et al.**

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

**Where?** Directly to the International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland  
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the International application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the International application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2  
NL-2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl  
Fax: (+31-70) 340-3016

Authorized officer

**Alex Schmidt**

# PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

## PCT

NOTIFICATION OF RECEIPT  
OF SEARCH COPY

(PCT Rule 25.1)

To:

IKEUCHI & SATO PATENT OFFICE  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-Shi  
OSAKA 530  
JAPAN

Date of mailing  
(day/month/year)

07/01/2000

Applicant's or agent's file reference

H623-01

IMPORTANT NOTIFICATION

International application No.

PCT/JP 99/ 06743

International filing date(day/month/year)

01/12/1999

Priority date (day/month/year)

03/12/1998

Applicant

NIPPON SHEET GLASS CO., LTD. et al.

**1. Where the International Searching Authority and the Receiving Office are not the same office:**

The applicant is hereby notified that the search copy of the international application was received by this International Searching Authority on the date indicated below.

**Where the International Searching Authority and the Receiving Office are the same office:**

The applicant is hereby notified that the search copy of the international application was received on the date indicated below.

16/12/1999

(date of receipt).

2. ☐ The search copy was accompanied by a nucleotide and/or amino acid sequence listing in computer readable form.

**3. Time limit for establishment of International Search Report**

The applicant is informed that the time limit for establishing the International Search Report is 3 months from the date of receipt indicated above or 9 months from the priority date, whichever time limit expires later

4. A copy of this notification has been sent to the International Bureau and, where the first sentence of paragraph 1 applies, to the Receiving Office.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2  
NL-2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl  
Fax: (+31-70) 340-3016

Authorized officer

ISA/EP

## PCT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING  
SUBMISSION OR TRANSMITTAL  
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

IKEUCHI, Hiroyuki  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-shi, Osaka 530-0047  
JAPON

|  |   |
|--|---|
| Date of mailing (day/month/year)<br>02 February 2000 (02.02.00)      |   |
| Applicant's or agent's file reference<br>H623-01                     | <b>IMPORTANT NOTIFICATION</b>   |
| International application No.<br>PCT/JP99/06743                      | International filing date (day/month/year)<br>01 December 1999 (01.12.99) |
| International publication date (day/month/year)<br>Not yet published | Priority date (day/month/year)<br>03 December 1998 (03.12.98)             |
| Applicant<br>NIPPON SHEET GLASS CO., LTD. et al                      |   |

- The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
- An **asterisk(\*)** appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- The **letters "NR"** appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

| <u>Priority date</u>   | <u>Priority application No.</u> | <u>Country or regional Office<br/>or PCT receiving Office</u> | <u>Date of receipt<br/>of priority document</u> |
|------------------------|---------------------------------|---|---|
| 03 Dec 1998 (03.12.98) | 10/344051                       | JP  | 21 Janu 2000 (21.01.00)                         |

|   |   |
|---|---|
| <p>The International Bureau of WIPO<br/>34, chemin des Colombettes<br/>1211 Geneva 20, Switzerland</p> <p>Facsimile No. (41-22) 740.14.35</p> | <p>Authorized officer<br/>Taïeb Akremi</p> <p>Telephone No. (41-22) 338.83.38</p> |
|---|---|

## PCT COOPERATION TREATY

PCT

NOTIFICATION OF RECEIPT OF  
RECORD COPY

(PCT Rule 24.2(a))

From the INTERNATIONAL BUREAU

To:

IKEUCHI, Hiroyuki  
Suite 401, Umeda Plaza Building  
3-25, Nishitenma 4-chome, Kita-ku  
Osaka-shi, Osaka 530-0047  
JAPON



|  |   |
|--|---|
| Date of mailing (day/month/year)<br>03 January 2000 (03.01.00) | IMPORTANT NOTIFICATION                          |
| Applicant's or agent's file reference<br>H623-01               | International application No.<br>PCT/JP99/06743 |

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

NIPPON SHEET GLASS CO., LTD. (for all designated States except US)  
YOSHIZAWA, Hideo (for US)

International filing date : 01 December 1999 (01.12.99)  
Priority date(s) claimed : 03 December 1998 (03.12.98)  
Date of receipt of the record copy  
by the International Bureau : 17 December 1999 (17.12.99)  
List of designated Offices :

AP : GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW  
EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM  
EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE  
OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG  
National : AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB,  
GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN,  
MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW

## ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- ☒ time limits for entry into the national phase  
☒ confirmation of precautionary designations  
☒ requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

|  |   |
|--|---|
| The International Bureau of WIPO<br>34, chemin des Colombettes<br>1211 Geneva 20, Switzerland<br>Facsimile No. (41-22) 740.14.35 | Authorized officer:<br>Y. KUWAHARA<br>Telephone No. (41-22) 338.83.38 |
|--|---|

## INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the "national phase" must be entered before each of the designated Offices indicated in the Notification of Receipt of Record Copy (Form PCT/IB/301) by paying national fees and furnishing translations, as prescribed by the applicable national laws.

The time limit for performing these procedural acts is **20 MONTHS** from the priority date or, for those designated States which the applicant elects in a demand for international preliminary examination or in a later election, **30 MONTHS** from the priority date, provided that the election is made before the expiration of 19 months from the priority date. Some designated (or elected) Offices have fixed time limits which expire even later than 20 or 30 months from the priority date. In other Offices an extension of time or grace period, in some cases upon payment of an additional fee, is available.

In addition to these procedural acts, the applicant may also have to comply with other special requirements applicable in certain Offices. **It is the applicant's responsibility** to ensure that the necessary steps to enter the national phase are taken in a timely fashion. Most designated Offices do not issue reminders to applicants in connection with the entry into the national phase.

For detailed information about the procedural acts to be performed to enter the national phase before each designated Office, the applicable time limits and possible extensions of time or grace periods, and any other requirements, see the relevant Chapters of Volume II of the PCT Applicant's Guide. Information about the requirements for filing a demand for international preliminary examination is set out in Chapter IX of Volume I of the PCT Applicant's Guide.

GR and ES became bound by PCT Chapter II on 7 September 1996 and 6 September 1997, respectively, and may, therefore, be elected in a demand or a later election filed on or after 7 September 1996 and 6 September 1997, respectively, regardless of the filing date of the international application. (See second paragraph above.)

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

## CONFIRMATION OF PRECAUTIONARY DESIGNATIONS

This notification lists only specific designations made under Rule 4.9(a) in the request. It is important to check that these designations are correct. Errors in designations can be corrected where precautionary designations have been made under Rule 4.9(b). The applicant is hereby reminded that any precautionary designations may be confirmed according to Rule 4.9(c) before the expiration of 15 months from the priority date. If it is not confirmed, it will automatically be regarded as withdrawn by the applicant. There will be no reminder and no invitation. Confirmation of a designation consists of the filing of a notice specifying the designated State concerned (with an indication of the kind of protection or treatment desired) and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.

## REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents, the following is recalled.

Where the priority of an earlier national, regional or international application is claimed, the applicant must submit a copy of the said earlier application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 16 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before that date of international publication of the international application, in which case that document will be considered to have been received by the International Bureau on the last day of the 16-month time limit (Rule 17.1(a)).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such request must be made before the expiration of the 16-month time limit and may be subjected by the receiving Office to the payment of a fee (Rule 17.1(b)).

If the priority document concerned is not submitted to the International Bureau or if the request to the receiving Office to prepare and transmit the priority document has not been made (and the corresponding fee, if any, paid) within the applicable time limit indicated under the preceding paragraphs, any designated State may disregard the priority claim, provided that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity to furnish the priority document within a time limit which is reasonable under the circumstances.

Where several priorities are claimed, the priority date to be considered for the purposes of computing the 16-month time limit is the filing date of the earliest application whose priority is claimed.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

|  |  |  |   |
|--|--|--|---|
| Applicant's or agent's file reference<br>H623-01   | <b>FOR FURTHER ACTION</b>                                |  | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
| International application No.<br>PCT/JP99/06743  | International filing date (day/month/year)<br>01/12/1999 | Priority date (day/month/year)<br>03/12/1998 |   |
| International Patent Classification (IPC) or national classification and IPC<br>C03B23/033 |  |  |   |
| Applicant<br>NIPPON SHEET GLASS CO., LTD. et al.   |  |  |   |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☒ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

|   |  |
|---|--|
| Date of submission of the demand<br><br>14/04/2000  | Date of completion of this report<br><br>20.10.2000                          |
| Name and mailing address of the international preliminary examining authority:<br><br> European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Authorized officer<br><br>De Ruiter, F<br><br>Telephone No. +49 89 2399 2921 |



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/JP99/06743

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-22 as originally filed

**Claims, No.:**

1-12 as received on 05/10/2000 with letter of 02/10/2000

**Drawings, sheets:**

1/15-15/15 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/JP99/06743

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

|                               |                  |
|-------------------------------|------------------|
| Novelty (N)                   | Yes: Claims 1-12 |
|                               | No: Claims       |
| Inventive step (IS)           | Yes: Claims 1-12 |
|                               | No: Claims       |
| Industrial applicability (IA) | Yes: Claims 1-12 |
|                               | No: Claims       |

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/JP99/06743

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Prior art continuous glass sheet bending methods are extensively discussed in the preamble to the description. These methods have the disadvantages that the glass sheets are marked by the rollers between which they are press bended, that the degree of freedom and the precision of the bend are insufficient and that it is difficult to attain the desired shape at the front and rear end of the sheets, seen in the conveying direction of the sheets. Consequently, the objects of the invention are as specified in the last full paragraph of page 4, which objects are achieved by the method of claim 1 and the apparatus of claim 7 to which there is no lead in the available prior art documents. Especially there is nowhere disclosed or suggested to use a steady upper forming member along which the glass sheets are conveyed with a portion of a belt between the forming member and the glass sheets. Therefore claims 1 and 7 appear to meet the requirements of Articles 33(2), (3) and (4) PCT.
2. As in claims 2 to 6 and 8 to 12 preferred embodiments of the method of claim 1 and the apparatus of claim 7 are defined these claims also appear to meet the requirements of the above articles.

**Re Item VI**

**Certain documents cited**

Certain published documents (Rule 70.10)

| Application No<br>Patent No | Publication date<br>(day/month/year) | Filing date<br>(day/month/year) | Priority date (valid claim)<br>(day/month/year) |
|-----------------------------|--------------------------------------|---------------------------------|---|
| PCT/JP98/05017              | 20.05.1999                           | 06.11.1998                      | 06.11.1997                                      |
|                             |                                      |                                 | 26.11.1997                                      |

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

---

International application No. PCT/JP99/06743

**Re Item VII**

**Certain defects in the international application**

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**Re Item VIII**

**Certain observations on the international application**

The summary of the invention does not correspond with the independent claims and therefore introduce obscurity into these claims (see the International Preliminary Examination Guidelines, C III, 4.3)

## CLAIMS

1. (Amended) A method for manufacturing a bent glass sheet comprising:  
heating a glass sheet in a heating furnace to a temperature where the  
5 glass sheet is changeable in shape,  
conveying the glass sheet out off the heating furnace, and  
bending the glass sheet by pressing the glass sheet together with at  
least one belt made of a heat-resistant material against a bending surface of  
a bending member,  
10 wherein the glass sheet is bent while the glass sheet is conveyed along  
the bending surface with the belt that travels between the glass sheet and  
the bending surface, and the bending surface is curved at least in the  
direction that is perpendicular to the conveying direction of the glass sheet.
- 15 2. (Amended) The method according to claim 1, wherein a degree of  
curvature of the bending surface gradually increases in the conveying  
direction of the glass sheet.
3. (Amended) The method according to claim 1, wherein the bending surface  
20 is also curved in the conveying direction of the glass sheet.
4. The method according to claim 1, wherein the glass sheet is conveyed  
with the belt so that the glass sheet gradually deviates from a direction in  
which the glass sheet is conveyed from the heating furnace.

AMENDED SHEET

5. The method according to claims 3 or 4, wherein the glass sheet is bent so as to have a predetermined curvature with respect to the conveying direction.

5 6. The method according to claim 1, further comprising cooling the glass sheet for quenching or annealing after separating the glass sheet from the belt.

7.(Amended) An apparatus for manufacturing a bent glass sheet  
10 comprising:

a heating furnace for heating a glass sheet to a temperature where the glass sheet is changeable in shape, and

a bending apparatus adjacent to the heating furnace so as to accept the glass sheet from the heating furnace and bend the glass sheet while  
15 conveying the glass sheet, the bending apparatus including a conveying passage for the glass sheet,

wherein the bending apparatus further includes a bending member having a bending surface and at least one belt made of a heat-resistant material for conveying the glass sheet, and the bending surface is curved at  
20 least in the direction that is perpendicular to the conveying direction of the glass sheet, and at least a portion of the belt is arranged along the bending surface of the bending member, thereby contacting this bending surface.

8. (Amended) The apparatus according to claim 7, wherein a degree of

AMENDED SHEET

curvature of the bending surface gradually increases in the conveying direction of the glass sheet.

9. (Amended) The apparatus according to claim 7, wherein the bending  
5 surface is also curved in the conveying direction of the glass sheet.

10. The apparatus according to claim 7, wherein the conveying passage  
gradually deviates from a direction in which the glass sheet is conveyed  
from the heating furnace.  
10

11. The apparatus according to claim 7, further including a cooling  
apparatus for quenching or annealing the glass sheet adjacent to the  
bending apparatus.

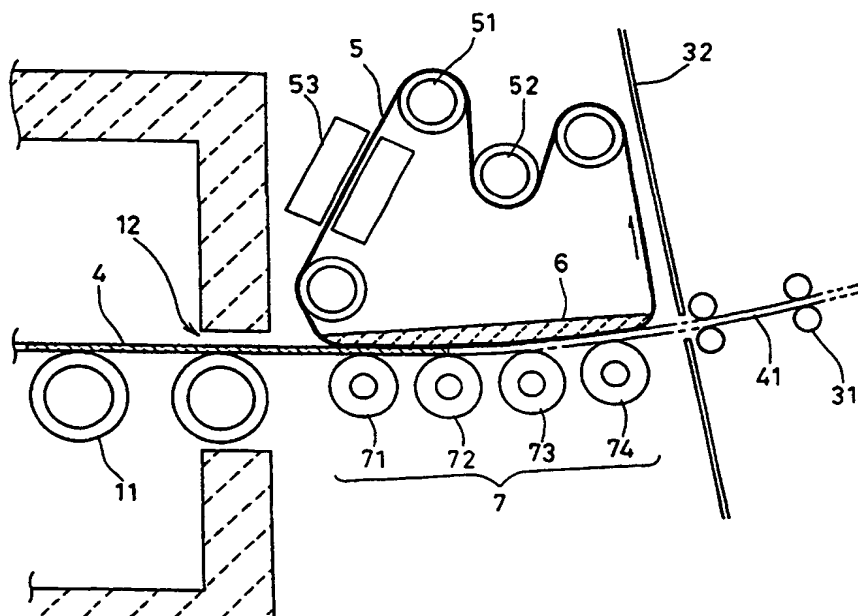
15 12. The apparatus according to claim 11, wherein the cooling apparatus  
includes a curved conveying passage for the glass sheet that has a  
predetermined curvature with respect to the conveying direction of the glass  
sheet.

AMENDED SHEET

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

|   |           |   |
|---|-----------|---|
| <b>(51) International Patent Classification <sup>7</sup> :</b><br><b>C03B 23/033</b>  | <b>A1</b> | <b>(11) International Publication Number:</b> <b>WO 00/32527</b><br><b>(43) International Publication Date:</b> 8 June 2000 (08.06.00)  |
| <b>(21) International Application Number:</b> PCT/JP99/06743<br><b>(22) International Filing Date:</b> 1 December 1999 (01.12.99)<br><b>(30) Priority Data:</b><br>10/344051                      3 December 1998 (03.12.98)                      JP<br><b>(71) Applicant (for all designated States except US):</b> NIPPON SHEET GLASS CO., LTD. [JP/JP]; 5-11, Doshomachi 3-chome, Chuo-ku, Osaka-shi, Osaka 541-0045 (JP).<br><b>(72) Inventor; and</b><br><b>(75) Inventor/Applicant (for US only):</b> YOSHIKAWA, Hideo [JP/JP]; Nippon Sheet Glass Co., Ltd., 5-11, Doshomachi 3-chome, Chuo-ku, Osaka-shi, Osaka 541-0045 (JP).<br><b>(74) Agents:</b> IKEUCHI, Hiroyuki et al.; Suite 401, Umeda Plaza Building, 3-25, Nishitenma 4-chome, Kita-ku, Osaka-shi, Osaka 530-0047 (JP). |           | <b>(81) Designated States:</b> AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).<br><br><b>Published</b><br><i>With international search report.</i> |

**(54) Title:** METHOD AND APPARATUS FOR MANUFACTURING BENT GLASS SHEET



**(57) Abstract**

A heated glass sheet is bent by pressing together with at least one belt made of a heat-resistant material against a bending member. The glass sheet is bent as the glass sheet is conveyed with the belt along the bending member, and the bending member is curved at least in a direction that is vertical to a conveying direction of the glass sheet. According to this invention, the bent glass sheets having surfaces on which defects such as marks of rollers are reduced can be produced efficiently.

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## DESCRIPTION

METHOD AND APPARATUS FOR MANUFACTURING  
BENT GLASS SHEET

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## FIELD OF THE INVENTION

The present invention relates to a method and an apparatus for manufacturing curved glass sheets. More precisely, the present invention relates to an efficient method and an apparatus for manufacturing curved glass sheets that are useful for example as window glass for buildings or vehicles.

## BACKGROUND OF THE INVENTION

Curved glass sheets are widely used for vehicles and buildings, and especially in the field of window glass for automobiles, there is a great demand for curved glass sheets due to design and aerodynamic considerations. Glass sheets that are mass-produced mainly using the float method primarily are formed into flat shapes. These flat glass sheets are formed into curved glass sheets in a secondary bending process, for which a number of industrial methods are known. Moreover, if the glass sheet is heated for the bending step, it is often quenched afterwards to temper it.

Methods for bending the glass that are widely employed include forming the heated glass sheet by sandwiching it with a pair of press molds. One type of these methods that is widely employed includes horizontal

conveyance of the heated glass sheet to the press position with rollers for example, in order to avoid press marks from tongs on the surface of the glass sheet. As a means for horizontally conveying the glass sheet, rollers are common, but belts are also used.

5           For example, Publication of Unexamined Japanese Patent Application No. Hei 3-50132 (JP-A-3-50132) discloses a method wherein a glass sheet is carried out of a furnace, conveyed by a belt to a pressing position, and press-formed together with the belt. This method takes advantage of the belt's flexibility to reduce the glass sheet's temperature  
10 decrease between heating and quenching. That is, the glass sheet is bent while it contacts the belt, and it is also quenched in this situation.

Furthermore, Publication of Unexamined Japanese Patent Application No. Hei 6-40732 (JP-A-6-40732) proposes methods for bending and tempering glass sheets that are improvements of this method.

15           However, regardless of the means for conveying the glass sheet, the glass sheet has to be temporarily stopped in the press mold during the forming step in these methods for bending glass sheets by press forming.

          With regard to the manufacturing efficiency of continuous production of curved glass sheets, methods have been proposed wherein the  
20 glass sheet is bent without stopping it on the manufacturing line. In some of these methods, the glass sheet is heated and softened inside a furnace while conveying it horizontally, and using the glass sheet's own weight, the glass sheet is gradually adapted to the surface form of for example an airbed for conveying the glass sheet. These methods (sag bending) are very

efficient for continuous production of glass sheets having the same curved shape, and have been employed with various improvements (see for example Publication of Unexamined Japanese Patent Application No. Hei 7-237928; JP-A-7-237928).

5           Moreover, Publication of Unexamined Japanese Patent Application No. Sho 55-75930; JP-A-55-75930) discloses a method wherein a glass conveying passage having a curvature is set up as a continuation to the carry-out opening of the furnace, and the glass sheet is bent while being conveyed by rollers on this conveying passage. Compared to a sag bending  
10 method, this method has a better heating efficiency and the shape of the curved glass can be changed easier.

Other methods have been proposed, wherein, while conveying the glass sheet with rollers, the glass sheet is bent not only in the direction in which it is conveyed, but also in the direction that is perpendicular to the  
15 conveying direction (referred to as "cross direction" in the following).

For example, Publication of Unexamined Japanese Patent Application No. Hei 3-174334 (JP-A-3-174334) proposes a method, wherein rollers made of an elastic body are arranged above and below the glass sheet, and by applying a stress onto these roller pairs from the outside so as to  
20 bend them into a certain shape, the glass sheet also is bent in the cross direction. Roller pairs for bending a glass sheet in a cross direction or for conveying a glass sheet that has been bent in the cross direction are disclosed for example in Publication of Unexamined Japanese Patent Application No. Sho 54-85217 (JP-A-54-85217) and No. Sho 55-75930 (JP-

A-55-75930).

However, when bending the glass sheet with rollers that are arranged on both sides of the conveying passage, pressure is exerted locally on the surface of the glass. Consequently, there is the problem that roller  
5 marks often appear on the surface of the glass sheet. Scratches and bumps on the surface of the glass sheet caused by the rollers often lead to optical defects, especially in the field of vehicle window glass.

Furthermore, in continuous bending with rollers, there is the problem that the degree of freedom for forming the glass sheet and the  
10 precision are insufficient. When bending with rollers, the glass sheet is bent while it spans the rollers. Consequently, it is difficult to attain the desired bent shape at the front edge and the rear edge of the glass sheet with respect to the conveying direction. And if bending is performed with elastic deformation of the rollers, it is difficult to attain the desired bending  
15 shape precisely.

## SUMMARY OF THE INVENTION

The present invention has been conceived upon consideration of these circumstances. It is an object of this invention to provide a method for bending a glass sheet while it is being conveyed, which has better  
20 manufacturing efficiency, where defects on the surface of the glass sheet do not occur easily, and where the degree of freedom and the precision for forming are improved. It is also an object of this invention to provide a manufacturing apparatus that is suitable for this manufacturing method.

In order to achieve these objects, a method for manufacturing a bent

glass sheet in accordance with the present invention comprises heating a glass sheet in a heating furnace to a temperature where the glass sheet is changeable in shape, conveying the glass sheet out from the heating furnace, and bending the glass sheet by pressing the glass sheet against a bending member. The glass sheet is pressed together with at least one belt made of a heat-resistant material. The glass sheet is bent as the glass sheet is conveyed with the belt along the bending member. The bending member is curved at least in a direction that is perpendicular to a conveying direction of the glass sheet (i.e. the cross direction).

10           With this manufacturing method, the glass sheet can be continuously bent together with the belt. Therefore, the glass sheet can be manufactured with better efficiency, while defects on the surface of the glass sheet are suppressed. Moreover, the degree of freedom and the precision for forming are improved.

15           In order to achieve these objects, an apparatus for manufacturing a curved glass sheet in accordance with the present invention comprises a heating furnace for heating a glass sheet to a temperature where the glass sheet is changeable in shape, and a bending apparatus adjacent to the heating furnace so as to accept the glass sheet from the heating furnace and  
20   bend the glass sheet as conveying the glass sheet. The bending apparatus includes a conveying passage for the glass sheet, a bending member and at least one belt made of a heat-resistant material for conveying the glass sheet. The bending member is curved at least in a direction that is perpendicular to a conveying direction of the glass sheet (i.e. the cross direction). At least

a portion of the belt is arranged along the bending member.

With this manufacturing apparatus, a curved glass sheet where defects on the surface of the glass sheet do not occur easily can be manufactured with better manufacturing efficiency, and with an improved degree of forming freedom and forming precision.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view of an embodiment of a manufacturing apparatus according to the present invention.

Figure 2 is a magnified cross-sectional view showing a bending apparatus of the manufacturing apparatus in Figure 1.

Figure 3 is a perspective view of an embodiment of a bending member.

Figure 4 shows cross-sectional views of the bending member of Figure 3.

Figure 5 is a cross-sectional view of an embodiment of another bending member.

Figure 6 is a cross-sectional view of an embodiment of a bending apparatus seen from the glass conveying direction.

Figure 7 is a magnified cross-sectional view showing a press roller shown in Figure 6.

Figure 8 is a perspective view showing the internal structure of a press roller according to another embodiment.

Figure 9 is a cross-sectional view of an embodiment of a bending apparatus using the press roller shown in Figure 8.

Figure 10 is a drawing showing a bending member and the shape of a glass sheet before and after the bending.

Figure 11 is a perspective view showing the shape of a glass sheet that can be formed with the present invention.

5        Figure 12 is a perspective view showing the shape of another glass sheet that can be formed with the present invention.

Figure 13 is a cross-sectional view showing another embodiment of the bending apparatus.

10       Figure 14 is a cross-sectional view showing yet another embodiment of the bending apparatus.

Figure 15 is a cross-sectional view showing another embodiment of the manufacturing apparatus of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

15       The following is a more detailed explanation of a preferred method and apparatus for manufacturing a curved glass sheet in accordance with the present invention.

In the method and the apparatus of the present invention, it is preferable that a degree of curvature of the bending member gradually increases toward a downstream conveying side of the glass sheet.

20       It is preferable that the bending member is also curved in the conveying direction of the glass sheet. It is also preferable that the conveying passage gradually deviates from a direction in which the glass sheet is conveyed from the heating furnace. The glass sheet is preferably conveyed with the belt along the conveying passage. According to these

preferable configurations, a glass sheet with complex curvature that is bent in two directions can be manufactured with high efficiency. It is preferable that the glass sheet is bent so as to have a predetermined curvature with respect to the conveying direction.

5           With regard to the cross direction of the glass sheet, the glass sheet can be bent into any desired shape, but it is also possible that the glass sheet has a certain curvature in its cross direction as well as in the conveying direction. In such a curved glass sheet, there are no partial changes of the form, and optical distortions (reflective distortions) hardly occur.

10           The curved glass sheet produced by the present invention may be cylindrical. However, the curved glass preferably has a first curvature radius of 5000mm to 50000mm along a first direction and a second curvature radius in the range no less than 500mm but less than 5000mm along a second direction that is perpendicular to the first direction.

15           If the glass sheet is bent so as to have a certain curvature in two directions, and if the curvature radius in the conveying direction of the glass sheet is large (slight bending) and the curvature radius in the cross direction of the glass sheet is small (pronounced bending), then the conveyance of the glass sheet becomes easy. On the other hand, if the curvature radius in the  
20           conveying direction of the glass sheet is small (pronounced bending) and the curvature radius in the cross direction of the glass sheet is large (slight bending), then the bending of the glass sheet becomes easy.

          In the method of the present invention, it is preferable that the glass is cooled for quenching or annealing after separating from the belt. When



the glass sheet is quenched, a tempered curved glass sheet can be obtained. Moreover, by adjusting the quenching degree, it is also possible to obtain semi-tempered curved glass sheets. The apparatus of the present invention preferably further includes a cooling apparatus for quenching or  
5 annealing the glass sheet adjacent to the bending apparatus. The cooling apparatus preferably includes a curved conveying passage for the glass sheet that has a predetermined curvature with respect to the conveying direction of the glass sheet.

The glass sheet is preferably bent while it is sandwiched between a  
10 pair of belts, because this improves the surface conditions and precision of the glass sheet even further. The belts are preferably arranged above and below the glass sheet conveying passage in the bending apparatus.

It is also preferable that the belts are suspended so that they describe an endless track, a part of which comprises the conveying passage  
15 of the glass sheet. Furthermore, it is preferable that rollers and belt temperature adjusting devices are arranged along the track described by the belt for controlling the belt tension. It is also preferable that the endless track of the belt is set within the bending apparatus and is separated from the glass sheet cooling apparatus.

20 In the apparatus of the present invention, it is preferable that the bending apparatus further comprises a belt-driving device for driving a belt together with the glass sheet. The belt-driving device conveys the glass sheet, which is pressed with the belt against the bending member, with an appropriate speed in the downstream direction.

In the apparatus of the present invention, it is preferable that the bending apparatus is provided with pressing members for pressing the glass sheet to the forming surface together with the belt. For the pressing member, a mold member provided with a surface having the inverse shape of the forming face of the forming block or free rollers can be used for example. As free rollers, integrated rollers having rotatable flexible sleeves attached to rods that are curved into a certain shape, or a plurality of free rollers that are arranged in the cross direction of the glass sheet can be used for example.

The following is a description of the preferred embodiments of the present invention with reference to the accompanying drawings.

#### First Embodiment

Fig. 1 is a cross-sectional view showing an embodiment of a manufacturing apparatus of the present invention. As is shown in Fig. 1, this manufacturing apparatus comprises a furnace 1, a bending apparatus 2, and a quenching apparatus 3, which use a continuous common glass conveying passage 41. Inside the furnace 1, the glass conveying passage 41 is substantially horizontal, inside the bending apparatus 2, it gradually slopes upwards and away from the horizontal direction, and inside the quenching apparatus 3, it describes a curve with a certain curvature radius  $R_1$ .

Fig. 2 is an enlarged cross-sectional view showing the bending apparatus 2 of the apparatus shown in Fig. 1. As shown in Fig. 2, in the bending apparatus, press rollers 7 are arranged below the glass conveying

passage 41, and a bending member (forming block) 6 is arranged above the glass conveying passage 41. Furthermore, the bending apparatus 2 is provided with a heat-resistant belt 5. A portion of the heat-resistant belt 5 is positioned along the glass conveying passage 41, between the glass  
5 conveying passage 41 and the forming block 6.

The heat-resistant belt 5 is suspended in a loop-shape by rollers and by the forming block, and forms an endless track. The rollers include a driving roller 51 and a tension roller 52. A driving device (not shown in the drawings) is connected to the driving roller 51. Moreover, by adjusting the  
10 position of the tension roller 52, the tension of the heat-resistant belt 5 can be adjusted to suitable conditions. Moreover, a belt temperature adjusting device 53 is arranged on both sides of the endless track of the heat-resistant belt 5. By heating or cooling with the belt temperature adjusting device 53, the temperature of the heat-resistant belt 5 can be kept within a range that  
15 is suitable for forming.

The heat-resistant belt 5 is made of a heat-resistant fiber, such as for example metal fiber, inorganic fiber, carbon fiber, or aramid fiber. The heat-resistant material for the heat-resistant belt 5 can be obtained by weaving, twilling, or knitting for example. It is also possible to form heat-  
20 resistant material into a felt or a web so as to obtain the heat-resistant belt 5. It is preferable that the heat-resistant belt 5 is sufficiently wide to cover the glass sheet conveyed along it.

As is shown in Fig. 2, a part of the surface of the forming block 6 is in contact with the endless track described by the heat-resistant belt 5, and a

part thereof faces the glass conveying passage 41. The surface of the forming block 6 that faces the glass conveying passage 41 functions as a forming surface for bending the glass sheet with pressure. As a material for the forming block 6, various metals and ceramics can be used. The  
5 forming block 6 can be formed in one piece as shown in Fig. 2, but it is also possible to form it by combination of a plurality of separate members.

Fig. 3 is a perspective view showing the forming face 61 of the forming block 6 from below the conveying passage. Figs. 4 (a) – (c) are cross-sectional views of the forming block 6 in Fig. 3, taken along the lines  
10 A–A, B–B, and C–C, respectively. Near the line of first contact 62, where the glass sheet contacts the forming block 6 first, the forming face 61 is flat (Fig. 4(a)). Proceeding in the conveying direction of the glass conveying passage 41, the forming face 61 bends gradually (Fig. 4(b)). Near the line of last contact 63, where the glass sheet separates from the forming block 6,  
15 the forming face 61 applies to the glass sheet a predetermined curved shape in the cross direction of the glass sheet (Fig. 4(c)). The curved shape of the forming face 61 shown in Fig. 6 will be the shape that is applied to the glass sheet in the cross direction. This curved shape can have for example a predetermined curvature radius  $R_2$ , or it can be for example an arch with an  
20 eccentric vertex, as shown in Fig. 5.

As is shown in Figs. 2 and 3, near the line of first contact, the forming face 61 is parallel to the direction in which the glass sheet is conveyed from the furnace (horizontal direction). However, proceeding in the conveying direction, the forming face gradually tilts upwards from the

horizontal direction. Near the line of last contact, the forming face 61 has substantially the same curvature radius  $R_1$  as the glass conveying passage inside the quenching apparatus.

It is preferable that a heater is attached to the forming block 6.

- 5 Thus, the forming block can be kept, like the belt, at a temperature that is appropriate for bending glass, and the glass sheet can be accurately formed from the initial stage in a continuous production.

As is shown in Fig. 2, the press rollers 7 are arranged along the lower side of the conveying passage 41. The purpose of these press rollers  
10 47 is to press the glass sheet against the forming block 6, while it is travelling along the conveying passage 41. Like the belt, the surface of the press rollers 47 is made of a heat-resistant material. It is preferable that a material such as felt is used that cushions the glass sheet. Furthermore, the press rollers 71, 72 etc. are non-driven rollers (free rollers) that rotate  
15 with little external force. It is of course also possible to connect the press rollers 7 to a driving mechanism to rotate them with the rotational velocity that is necessary to convey the glass sheet.

The number of press rollers 7 can be determined in accordance with the desired curved shape for the glass sheet, but in general, at least two  
20 rollers are necessary. It is preferable to provide at least five rollers.

For the rollers 71, 72 etc., a rod can be used that is made, for example, of an elastic body to which a supporting member for supporting the glass sheet has been attached. For this supporting member, a plurality of disk-shaped or cylindrical flexible sleeves can be used, for example.

Furthermore, the rollers do not have to be formed of one body, and it is also possible to use a plurality of rollers across the cross direction of the glass sheet.

Fig. 6 is a cross-sectional view of a bending apparatus using a plurality of rollers as press rollers 74 (see Fig. 2), taken from the furnace side. The press rollers 74a, 74b, 74c, etc. in Fig. 6 are attached to the ends of rods 75a, 75b, etc. Moreover, the rods 75a, 75b, etc. are inserted into a base member 79 from which they can freely ascend and descend. The rods 75a, 75b, etc. are pushed upwards by springs 76a, 76b, etc., whose lower end is defined by the base member 79. As a result, the rollers 74a, 74b, 74c, etc. push the heat-resistant belt 5 (and when a glass sheet is passed along, the glass sheet and the heat-resistant belt) against the forming block 6.

Fig. 7 shows a magnification of the press roller 74b. The press roller 74b is attached to an axis 78b that is supported rotatably by a supporting member 77b. The supporting member 77b is attached to the end of the rod 75b and is freely tiltable in cross direction of the glass sheet. Thus, a plurality of free rollers 74a, 74b, 74c, etc. that are arranged in cross direction of the glass sheet 4 are used as members for pressing the glass sheet 4 together with the belt 5 against the forming block 6. If these rollers are tiltable in the cross direction of the glass sheet, and each roller is pressed into the direction of the forming block, then each portion of the surface of the glass sheet can be pressed precisely against the forming block.

Figs. 8 and 9 show an example of an integrated press roller. As is shown in Fig. 8, this roller 65 comprises a bendable core 66 made of an

elastic material, rods 67 made of elastic material that are arranged around and along the core 66, a coil spring 68 wrapped around the core 66 and the rods 67, and a sleeve 69 made of a heat-resistant material that covers the coil spring 68. As is shown in Fig. 9, the surface of the glass sheet is  
5 precisely pressed against the forming block by supporting both ends of the roller 65 rotatably with a supporting member 64 provided with a mechanism to adjust the height.

For the furnace 1, in general a conventionally used apparatus can be used. There is no particular limitation concerning the glass conveying  
10 means in the furnace 1, but rollers 11 are preferable, considering heating efficiency.

In the quenching apparatus 3, the glass conveying passage is provided with a curvature radius  $R_1$  in conveying direction corresponding to the curvature radius that has been imparted on the glass sheet. Conveyor  
15 rollers 31 are arranged on both sides of the glass conveying passage (see Fig. 2). For the conveyor rollers 31, rollers are used that are provided with a curved shape that has been applied to the glass in the cross direction. Nozzles (not shown in the drawing) for blowing cool air are arranged along the glass conveying passage 41. However, the curved glass also can be  
20 gradually cooled (annealed) without blowing cool air against it, while being conveyed along the conveying passage. Moreover, a converter for changing the conveying direction of the glass sheet into a certain direction (for example the horizontal direction) can be set up further downstream of the quenching apparatus 3.

The following is an example of a method for manufacturing a curved glass sheet using the above-described apparatus. A glass sheet 4 made of soda lime silicate glass is heated in a furnace 1 to a temperature near its softening point (for example to a temperature between the strain point and the softening point of the glass), while conveying rollers 11 inside the furnace 1 convey it in horizontal direction, and is released in a shapeable state in the horizontal direction through a carry-out opening 12 of the furnace 1. When the glass sheet 4 is inserted into the bending apparatus 2, it is sandwiched between the first press roller 71, which is located at the most upstream position, and the forming block 6. The roller 71 presses the glass sheet 4 against the forming block 6 through the belt 5.

The belt 5, which is made for example of a belt cloth using stainless steel fibers, travels downstream in the glass conveying direction with a predetermined velocity while sliding along the forming face, guiding the glass sheet 4 downstream. Then, the front end of the glass sheet 4 reaches the second press roller 72, as is shown in Fig. 2. The travelling speed of the belt 5 is preferably set to a speed in the range from 80mm/sec to 400mm/sec. At this stage, the glass sheet 4 is still substantially flat, since no bending has been performed yet.

From the situation shown in Fig. 2, the glass sheet is conveyed further downstream. First, the glass sheet 4 is pressed against the forming block 6 while the second press roller 72 slowly lifts the front end of the glass sheet upwards. At this position, the forming face of the forming block recedes slightly upwards, while the glass sheet is also bent slightly in the



cross direction. Thus, the bending of the glass sheet 4 begins at this stage.

During the bending, the entire upper surface of the glass sheet 4, which is pressed upwards by the press rollers 7, contacts the belt 5, so that the glass sheet 4 is conveyed while keeping a stable orientation.

5 Fig. 10 shows the glass sheet before and after the bending, together with the forming face 61. As is shown in Fig. 10, the flat glass surface 4 mirrors the shape of the forming face 61, so that for example a curvature radius of  $R_1$  in the conveying direction of the glass sheet and for example a curvature radius of  $R_2$  in the cross direction are imparted on the curved  
10 glass 44. Thus, the glass sheet is bent while traveling in the glass conveying passage.

Referring to Figs. 11 and 12, the following explains the shapes of the curved glass sheet that can be formed with the method and the apparatus of the present invention. Fig. 11 is a perspective view of a glass sheet that  
15 has been formed using the forming face 61 shown in Fig. 10. Thus, in accordance with the present invention, bending with a curvature in two directions (two-dimensional bending) can be realized. Moreover, as shown in Fig. 12 (and by the dashed line in Fig. 11), by not imparting a curvature in the conveying direction, a cylindrical glass sheet can be formed. When the  
20 glass sheet is formed with the present invention, a constant curvature radius  $R_1$  in the conveying direction (longitudinal direction) is imparted on the glass sheet, or no curvature radius is imparted (i.e.  $R_0 = \infty$  in Fig. 12). On the other hand, with respect to the cross direction (lateral direction) of the glass sheet, a constant curvature radius  $R_2$  can be imparted, or a

plurality of curvature radii can be combined (as for example when forming with the forming block shown in Fig. 5).

After the glass sheet has passed through the bending region and has been formed into a predetermined shape, it passes a slit in a partition wall 32 and is conveyed into the quenching apparatus. In the quenching apparatus, the glass sheet 44 is tempered or semi-tempered by blowing cool air onto it while conveying it at a constant speed with the conveying rollers 31. The curved glass also can be annealed without quenching.

With this method, surface defects such as roller marks, that are difficult to avoid with conventional methods, do not occur, and a curved glass sheet can be continuously manufactured. Curved glass sheets with a curvature radius of for example 1300mm in the conveying direction and a curvature radius of 50000mm in the cross direction were obtained. Moreover, when forming a glass sheet with a forming block having a forming face that was unsymmetrical in the cross direction of the glass sheet, it was equally possible to manufacture a curved glass sheet efficiently without surface defects.

In this method, there is no need to stop the glass sheet for forming it. During the bending, at least one surface of the glass sheet is retained by the belt. Consequently, a curved glass sheet with little surface defects can be manufactured continuously and with high efficiency. There is no particular limitation to the thickness of the glass sheet to be manufactured.

### Second Embodiment

Fig. 13 is a cross-sectional view showing the bending region of an

apparatus according to another embodiment of the present invention.

Except for the portion pushing the glass sheet upwards, this apparatus is the same as the apparatus shown in Fig. 2.

In the apparatus shown in Fig. 13, a second belt 9 is suspended by  
5 lower press rollers 8 below the glass conveying passage 41. Via the first belt 5 and the second belt 9, the press rollers 8 press the glass sheet 4 against the forming block 6.

Like the first belt 5, the second belt 9 is suspended in a loop-shape by rollers that include a driving roller 91 and a tension roller 92, and forms  
10 an endless track. A driving device (not shown in the drawings) is connected to the driving roller 91. By adjusting the position of the tension roller 92, the tension of the second belt 9 can be adjusted to suitable conditions. Moreover, a belt temperature adjusting device 93 is arranged on both sides of the endless track of the second belt 9. The temperature of the second  
15 belt 9 can be adjusted by heating or cooling with the temperature adjusting device 93. Preferable materials and manufacturing methods for the second belt 9 are the same as for the first belt 5.

With the apparatus shown in Fig. 13, the glass sheet 4 can be conveyed while sandwiching both faces between the belts 5 and 9. Thus,  
20 the condition of the surface of the curved glass and the degree of freedom for shaping it can be improved even further.

### Third Embodiment

Fig. 14 is a cross-sectional view showing the bending region of an apparatus according to another embodiment of the present invention.

Except for the portion pushing the glass sheet upwards, this apparatus is the same as the apparatus shown in Figs. 2 and 13.

In the apparatus shown in Fig. 14, a second belt 9 is suspended by a forming block 10 below the glass conveying passage 41. Via the first belt 5 and the second belt 9, the lower forming block 10 presses the glass sheet 4 upwards against the forming block 6. At the same time, the upper forming block 6 presses the glass sheet 4 against the lower forming block 10. Because the forming face of the lower forming block 10 has the inverse shape of the forming face of the upper forming block 6, both forming faces can be fitted into each other.

With the apparatus shown in Fig. 14, the two faces of the glass sheet 4 are sandwiched by the belts 5 and 9, and the glass sheet is transported while this pressure is being exerted on it. Consequently, like in the apparatus shown in Fig. 13, the surface condition of the curved glass sheet can be improved even further.

In the apparatus in Figs. 13 and 14, which have belts arranged on both sides of the conveying passage, the glass can be conveyed by driving both belts, but it is also possible to have one belt running freely, and convey the glass sheet by driving only the other belt.

#### 20 Fourth Embodiment

A curved glass sheet of the same shape as the one manufactured in the first embodiment was manufactured, exchanging conveying direction and cross direction. In other words, the curvature radius in the glass sheet conveying direction was set to 50000mm and in cross direction to 1300mm.

For the bending shape, basically the same apparatus as shown in Figs. 1 and 2 was used.

However, since the curvature radius  $R_1$  imparted on the glass sheet with respect to the conveying direction was larger, the conveying passage 41 in the quenching apparatus described a smoother curve, and as a result, the cooled glass sheet could be retrieved at a lower position and at an angle that was closer to the horizontal plane than shown in Fig. 1. This facilitated subsequent handling.

Thus, by setting  $R_1 > R_2$ , wherein  $R_1$  is the curvature radius in the conveying direction and  $R_2$  is the curvature radius in the cross direction, the conveyance of the glass sheet in the quenching apparatus and subsequent handling of the glass sheet was facilitated.

#### Fifth Embodiment

Fig. 15 is a cross-sectional view showing a manufacturing apparatus according to another embodiment of the present invention. This apparatus can be used when the glass sheet is bent only in the cross direction. Except for the fact that the furnace 1, the bending apparatus 2, and the quenching apparatus 3 are arranged along a common conveying passage 42 that extends in the horizontal direction, this apparatus is basically the same as the apparatus of the first embodiment.

However, in the bending apparatus 2, the forming block is provided with a forming face that curves only in the cross direction of the glass sheet, progressively towards the downstream conveying side. Moreover, in the quenching apparatus 3, conveying rollers 33 are arranged only on the lower

side of the glass conveying passage 42. Thus, if a glass sheet is bent into cylindrical shape with a curvature radius in only one direction, and if a curvature only in the cross direction is to be imparted, then the glass sheet can be conveyed in the horizontal direction. Therefore, subsequent

5 handling and conveyance of the glass sheet becomes easier. With the apparatus shown in Fig. 15, a cylindrical glass sheet as shown in Fig. 12 can be formed.

#### INDUSTRIAL APPLICABILITY OF THE INVENTION

As has been detailed above, in accordance with the present invention

10 a curved glass sheet with reduced surface defects such as roller marks can be manufactured efficiently by curving the glass sheet while conveying it with a belt. Moreover, in accordance with the present invention, a curved glass sheet can be manufactured that has a higher degree of forming freedom and a higher precision than the prior art. The curved glass sheets

15 manufactured according to this invention are suitable as window glass for vehicles and buildings etc.

## CLAIMS

1. A method for manufacturing a bent glass sheet comprising:  
heating a glass sheet in a heating furnace to a temperature where the  
5 glass sheet is changeable in shape,  
conveying the glass sheet out from the heating furnace, and  
bending the glass sheet by pressing the glass sheet together with at  
least one belt made of a heat-resistant material against a bending member,  
wherein the glass sheet is bent as the glass sheet is conveyed with the  
10 belt along the bending member, and the bending member is curved at least  
in a direction that is perpendicular to a conveying direction of the glass  
sheet.
2. The method according to claim 1, wherein a degree of curvature of the  
15 bending member gradually increases toward a downstream conveying side  
of the glass sheet.
3. The method according to claim 1, wherein the bending member is also  
curved in the conveying direction of the glass sheet.
- 20 4. The method according to claim 1, wherein the glass sheet is conveyed  
with the belt so that the glass sheet gradually deviates from a direction in  
which the glass sheet is conveyed from the heating furnace.

5. The method according to claims 3 or 4, wherein the glass sheet is bent so as to have a predetermined curvature with respect to the conveying direction.

5 6. The method according to claim 1, further comprising cooling the glass sheet for quenching or annealing after separating the glass sheet from the belt.

7. An apparatus for manufacturing a bent glass sheet comprising:  
10 a heating furnace for heating a glass sheet to a temperature where the glass sheet is changeable in shape, and

a bending apparatus adjacent to the heating furnace so as to accept the glass sheet from the heating furnace and bend the glass sheet as conveying the glass sheet, the bending apparatus including a conveying passage for the  
15 glass sheet,

wherein the bending apparatus further includes a bending member and at least one belt made of a heat-resistant material for conveying the glass sheet, and the bending member is curved at least in a direction that is perpendicular to a conveying direction of the glass sheet, and at least a  
20 portion of the belt is arranged along the bending member.

8. The apparatus according to claim 7, wherein a degree of curvature of the bending member gradually increases toward a downstream conveying side of the glass sheet.



9. The apparatus according to claim 7, wherein the bending member is also curved in the conveying direction of the glass sheet.
10. The apparatus according to claim 7, wherein the conveying passage  
5 gradually deviates from a direction in which the glass sheet is conveyed from the heating furnace.
11. The apparatus according to claim 7, further including a cooling  
apparatus for quenching or annealing the glass sheet adjacent to the  
10 bending apparatus.
12. The apparatus according to claim 11, wherein the cooling apparatus  
includes a curved conveying passage for the glass sheet that has a  
predetermined curvature with respect to the conveying direction of the glass  
15 sheet.

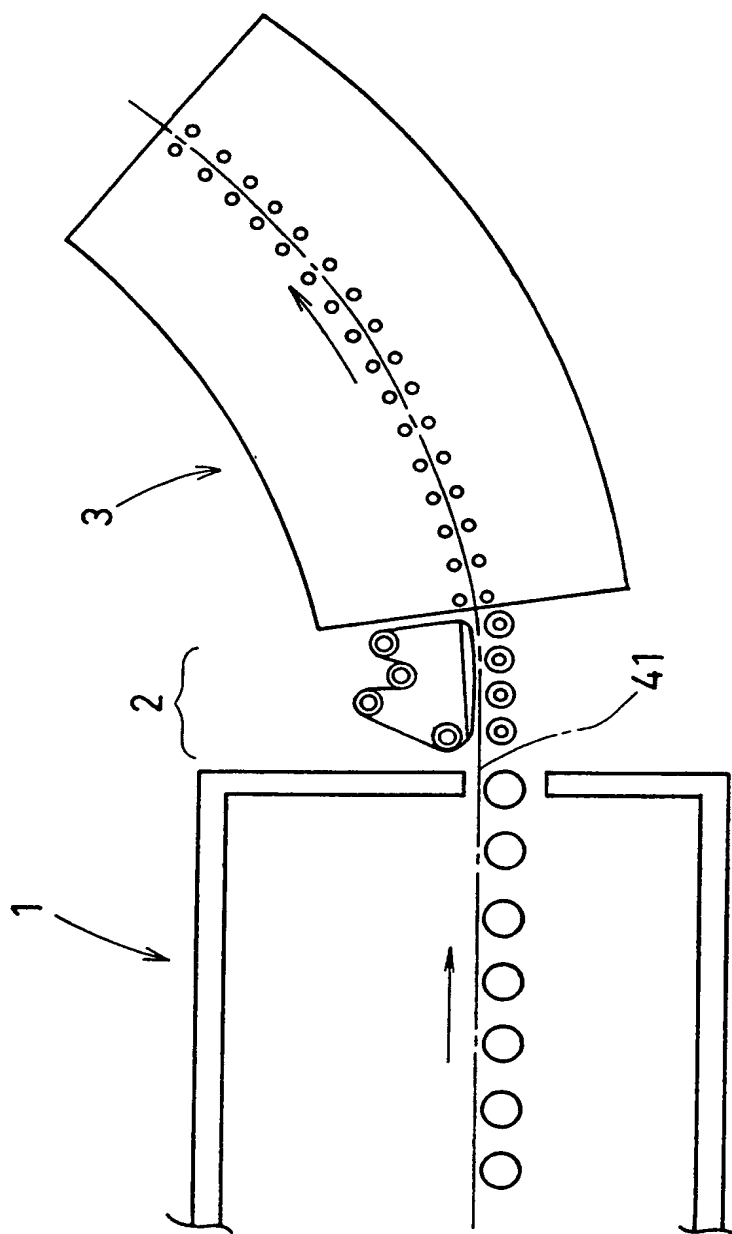


FIG. 1

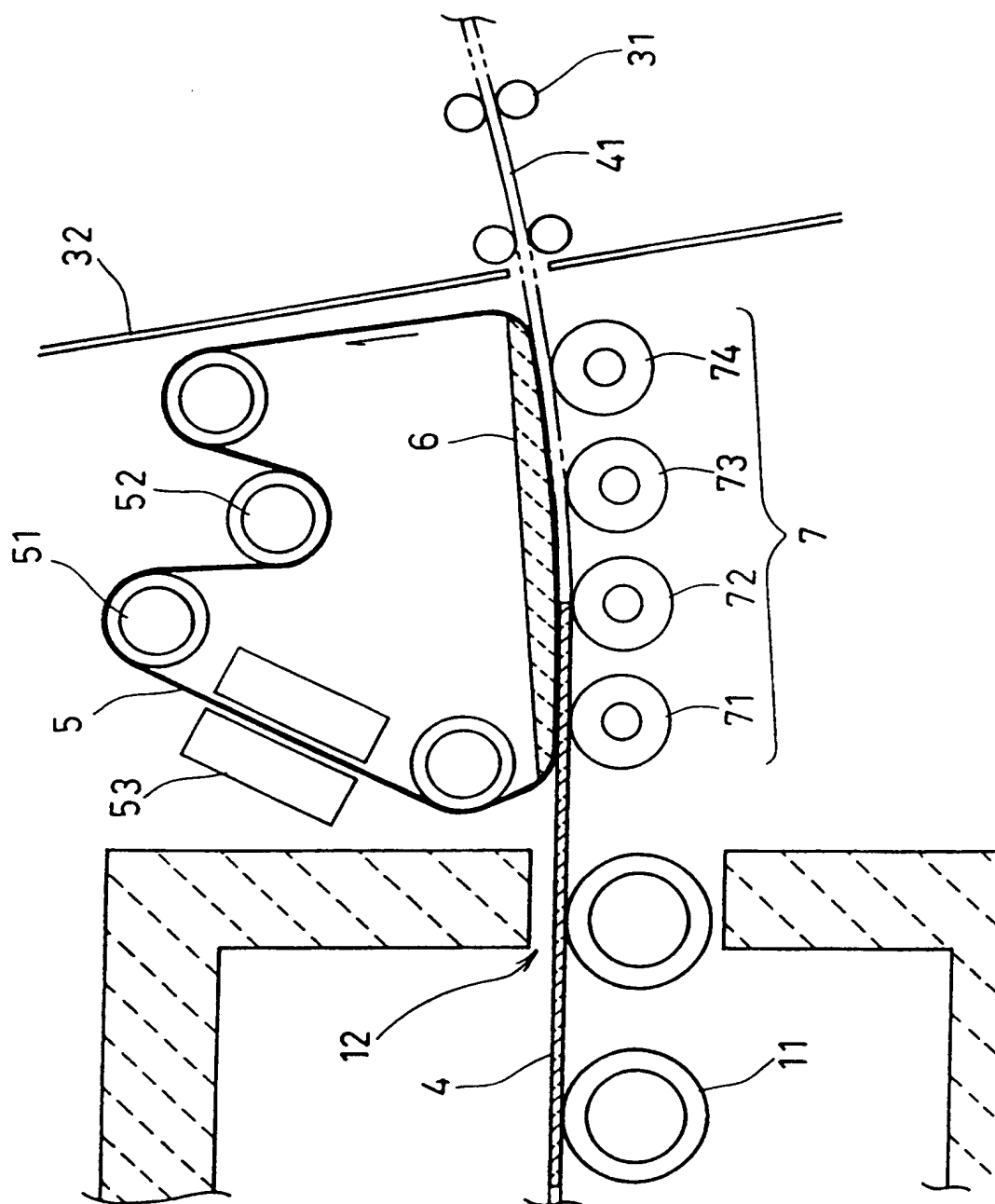


FIG. 2

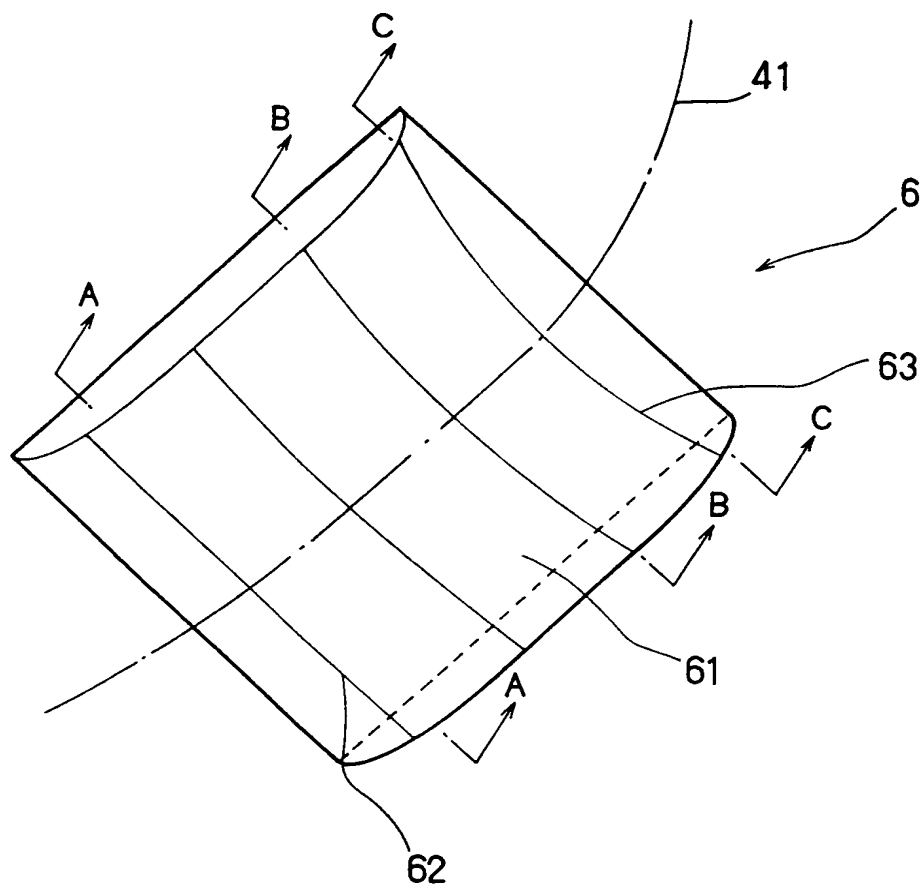


FIG. 3

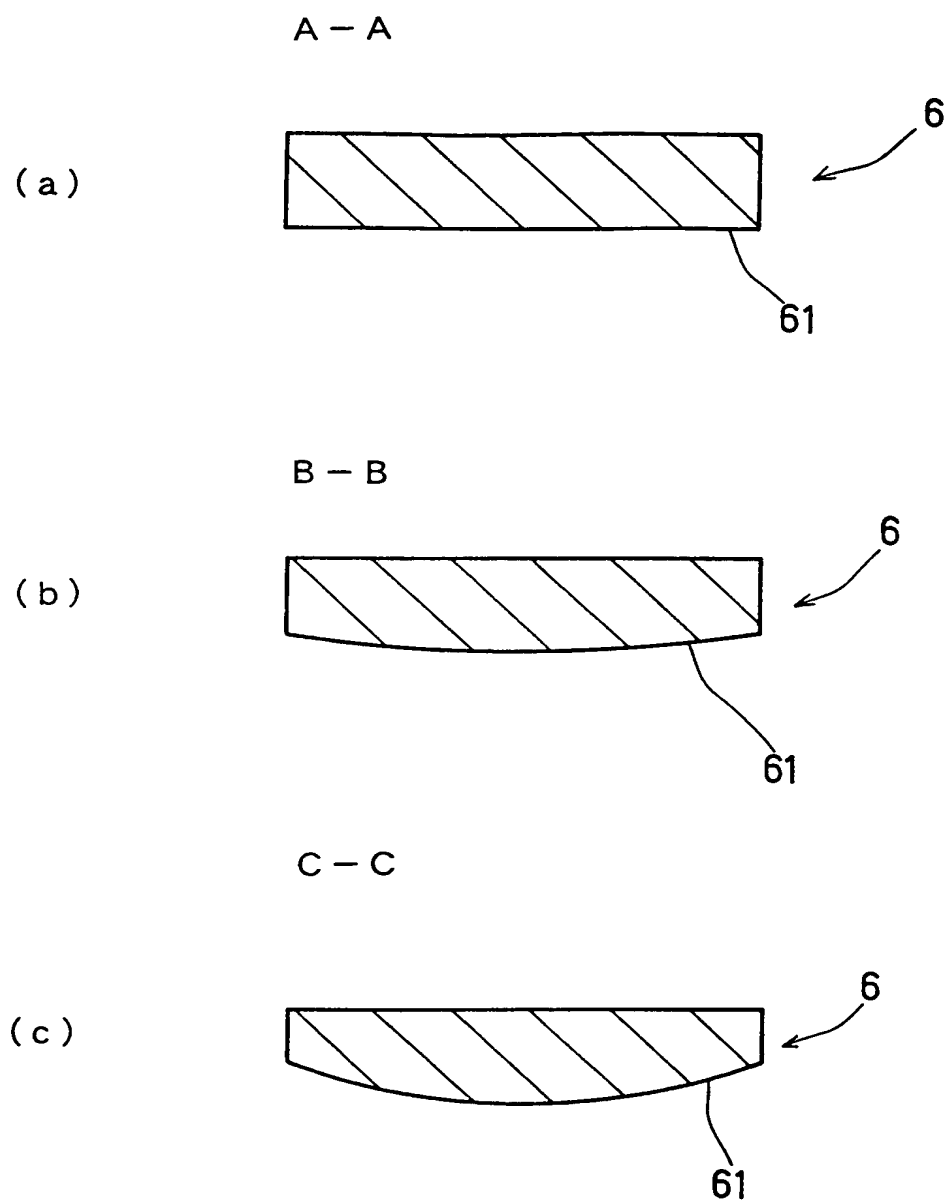


FIG. 4

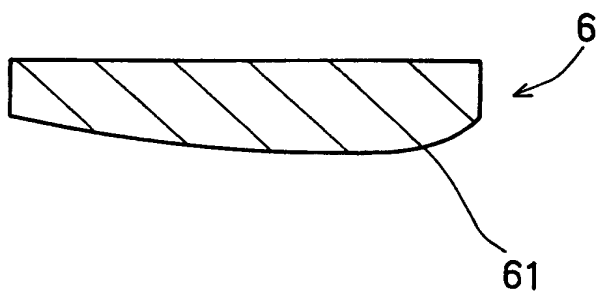


FIG. 5

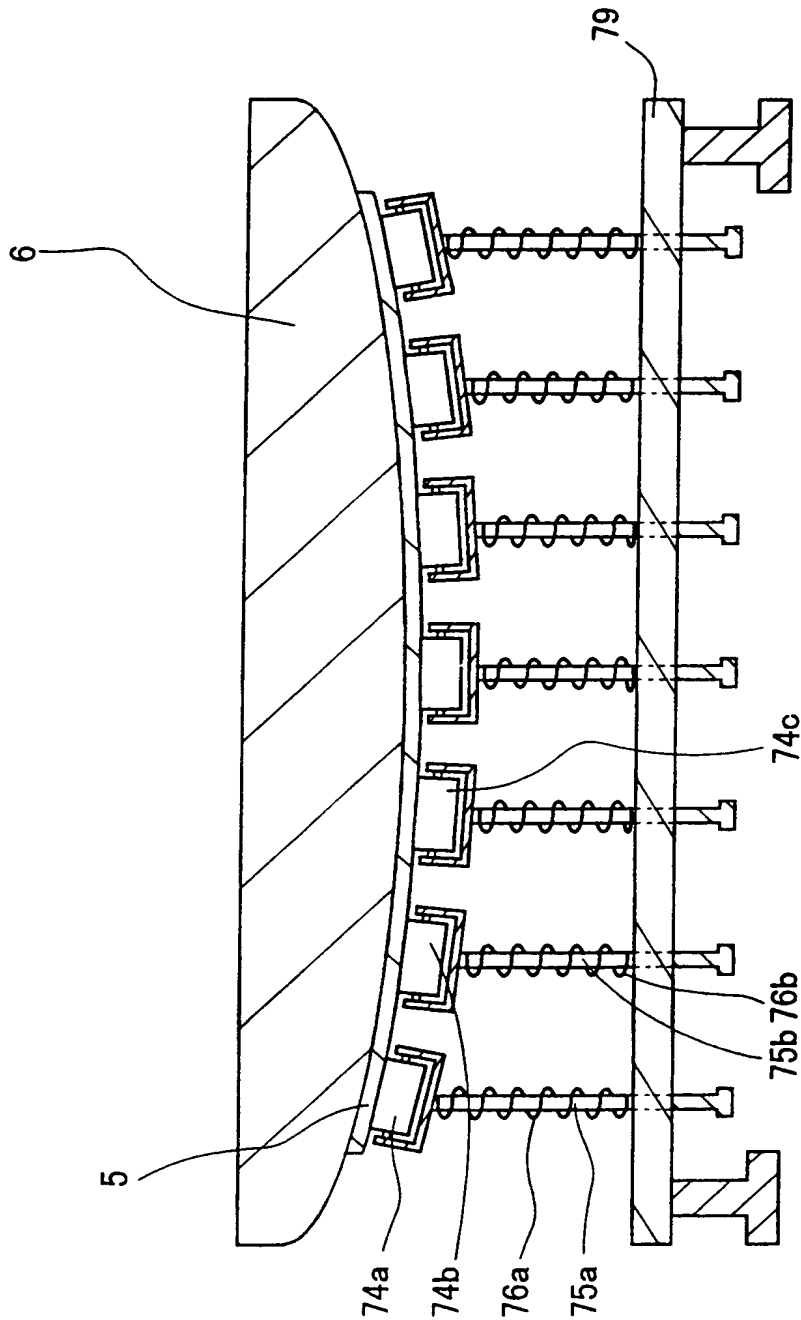


FIG. 6

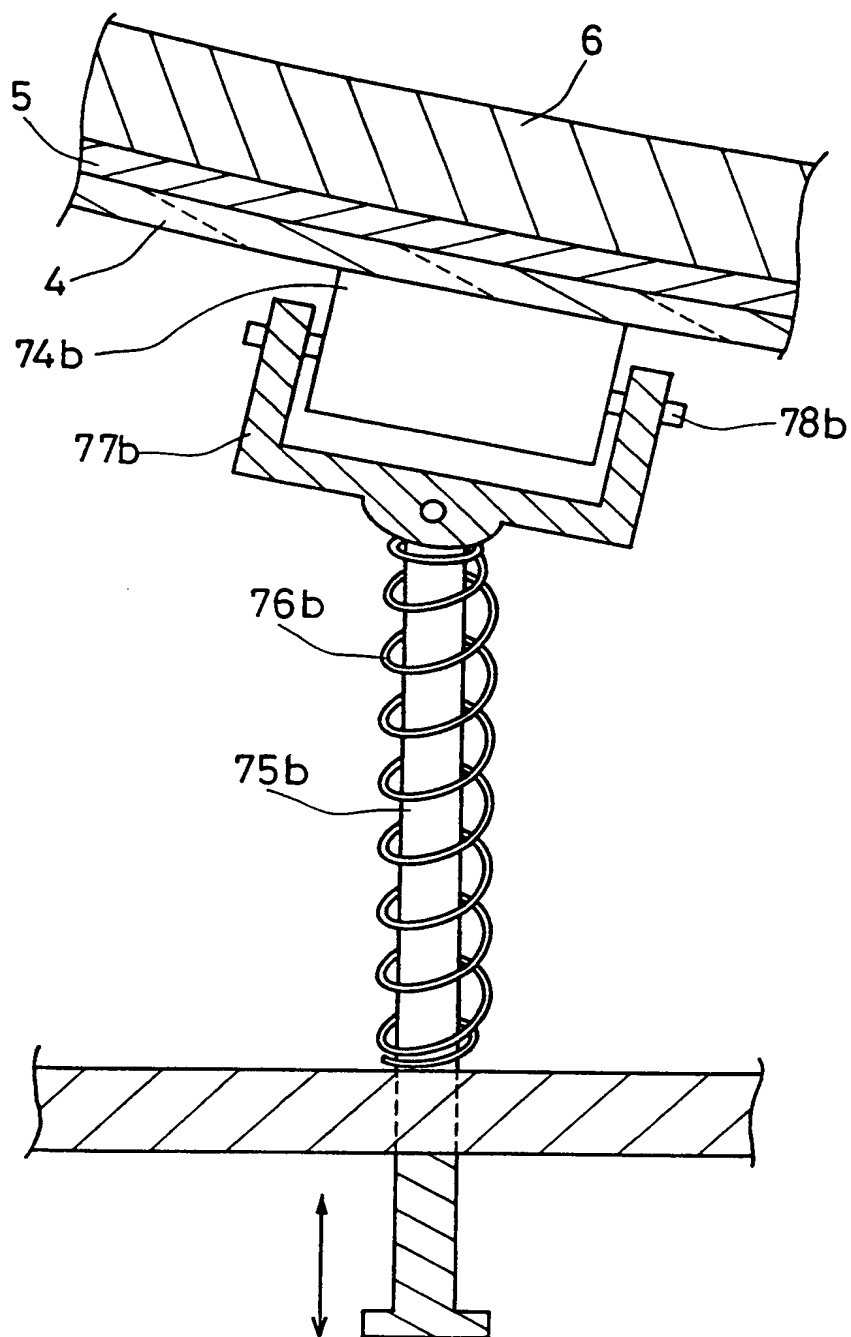


FIG. 7



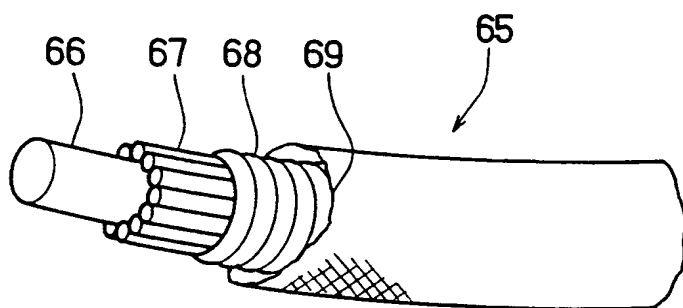


FIG. 8

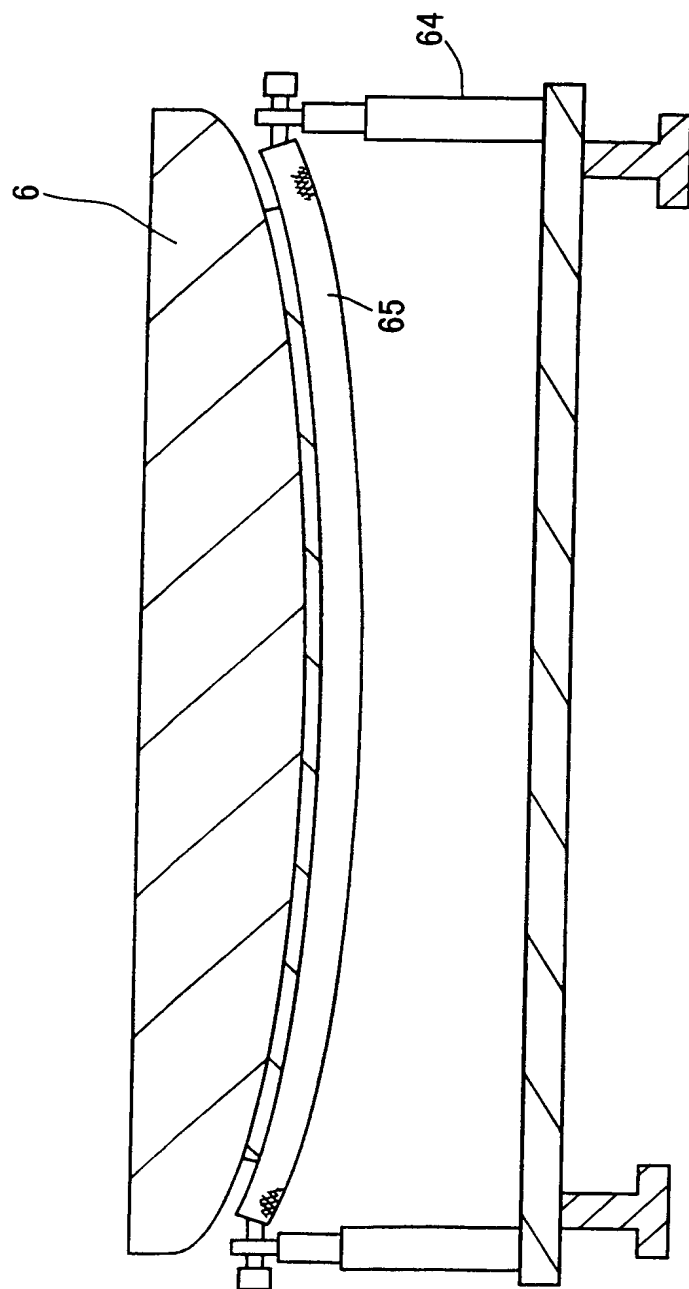
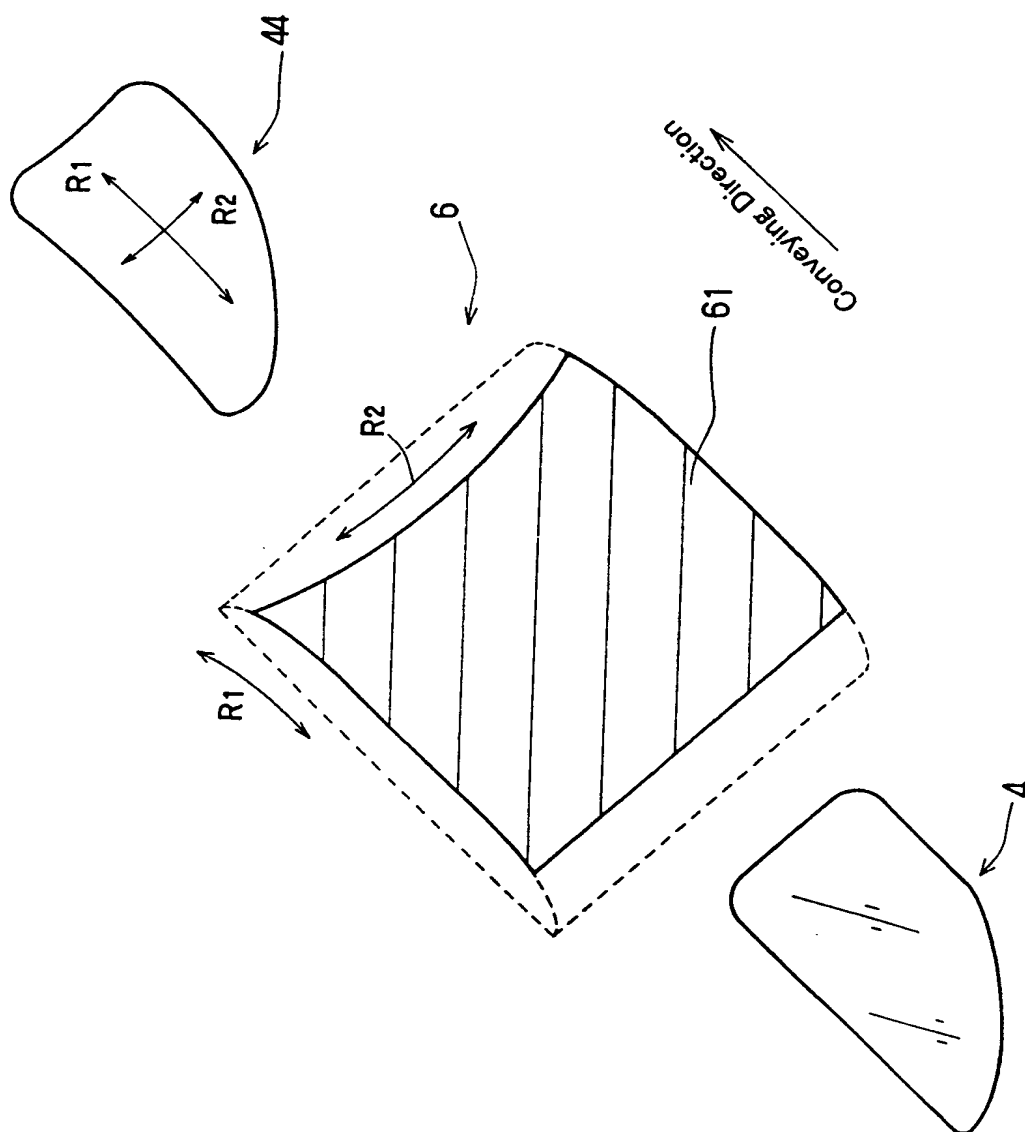


FIG. 9



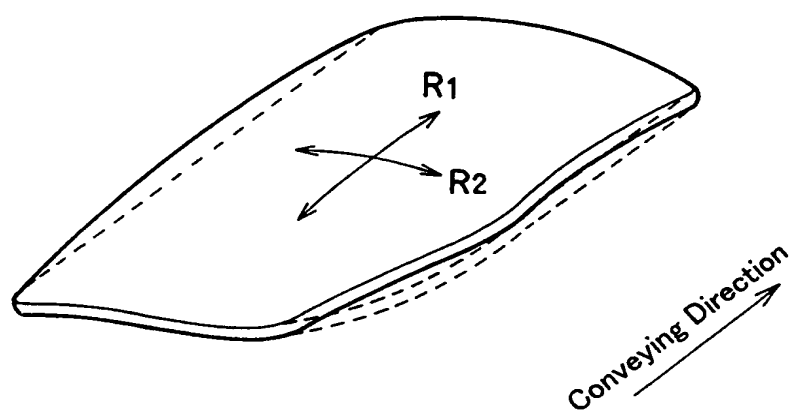


FIG. 11

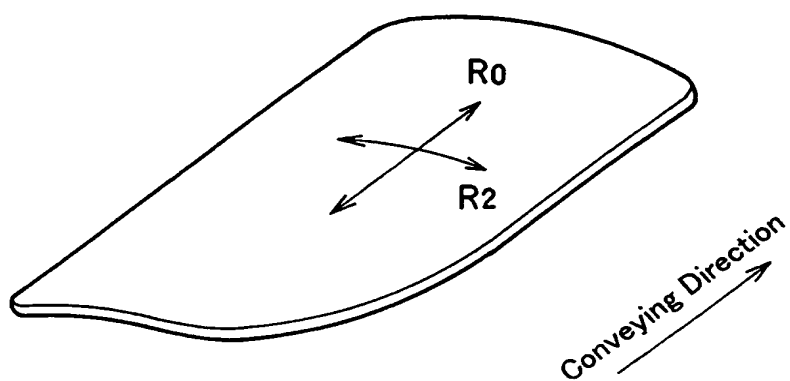


FIG . 12

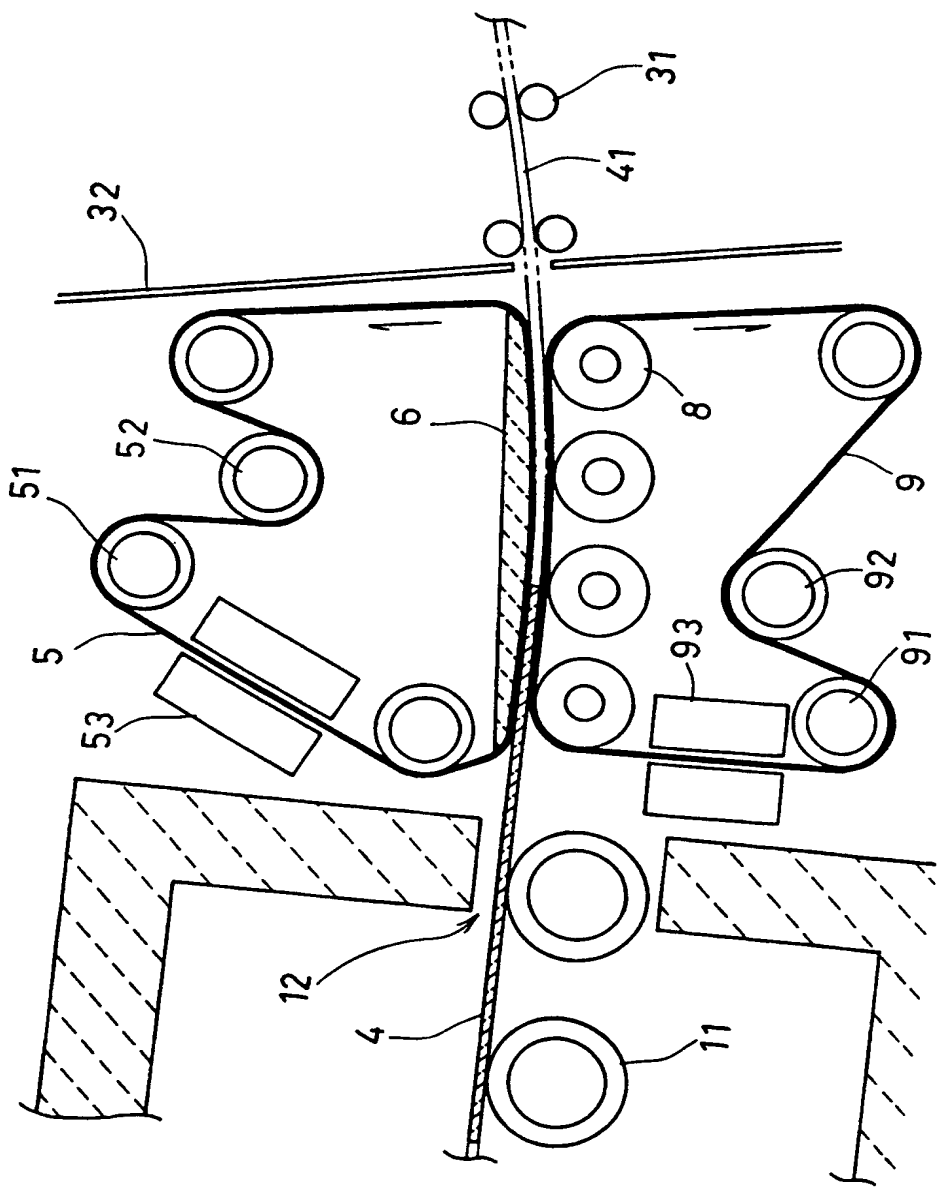


FIG. 13

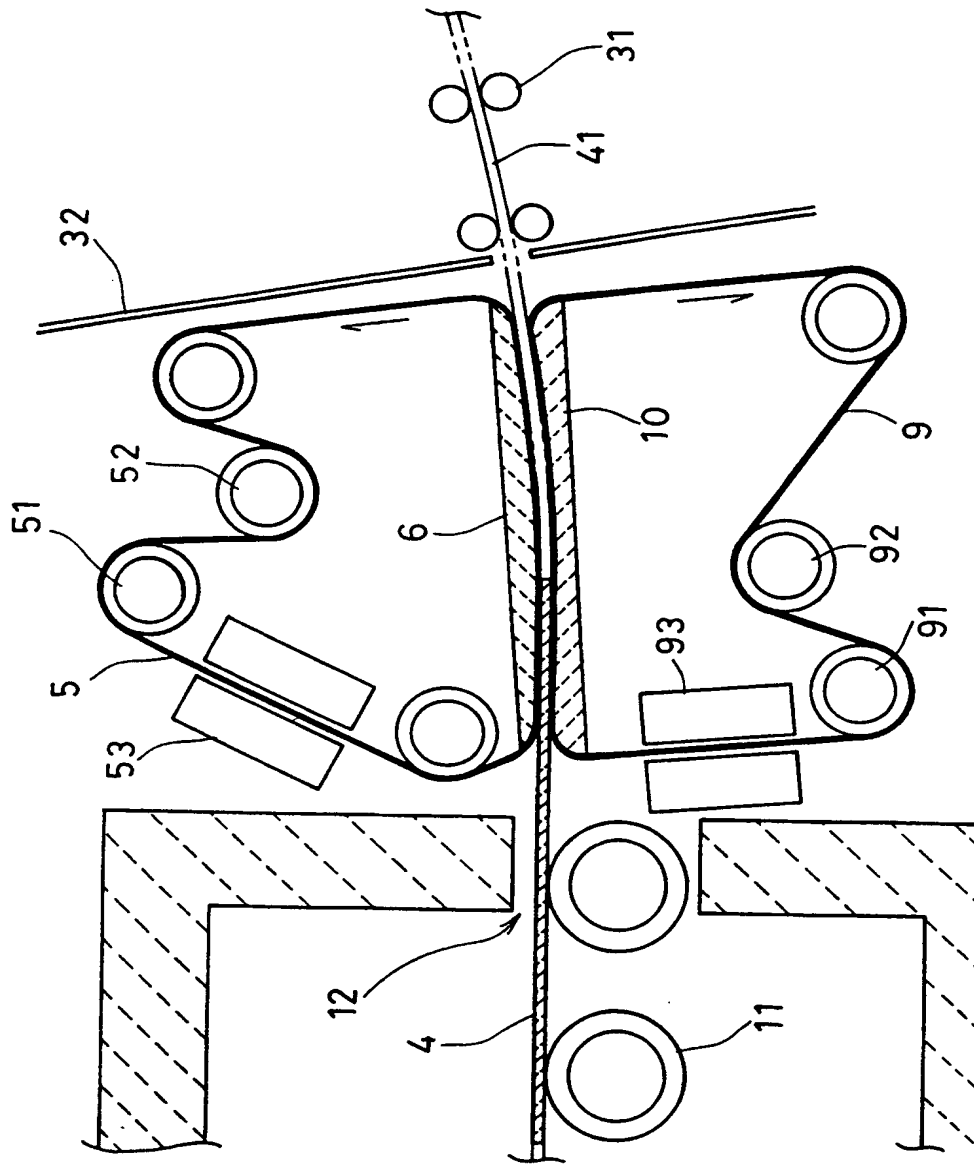


FIG. 14

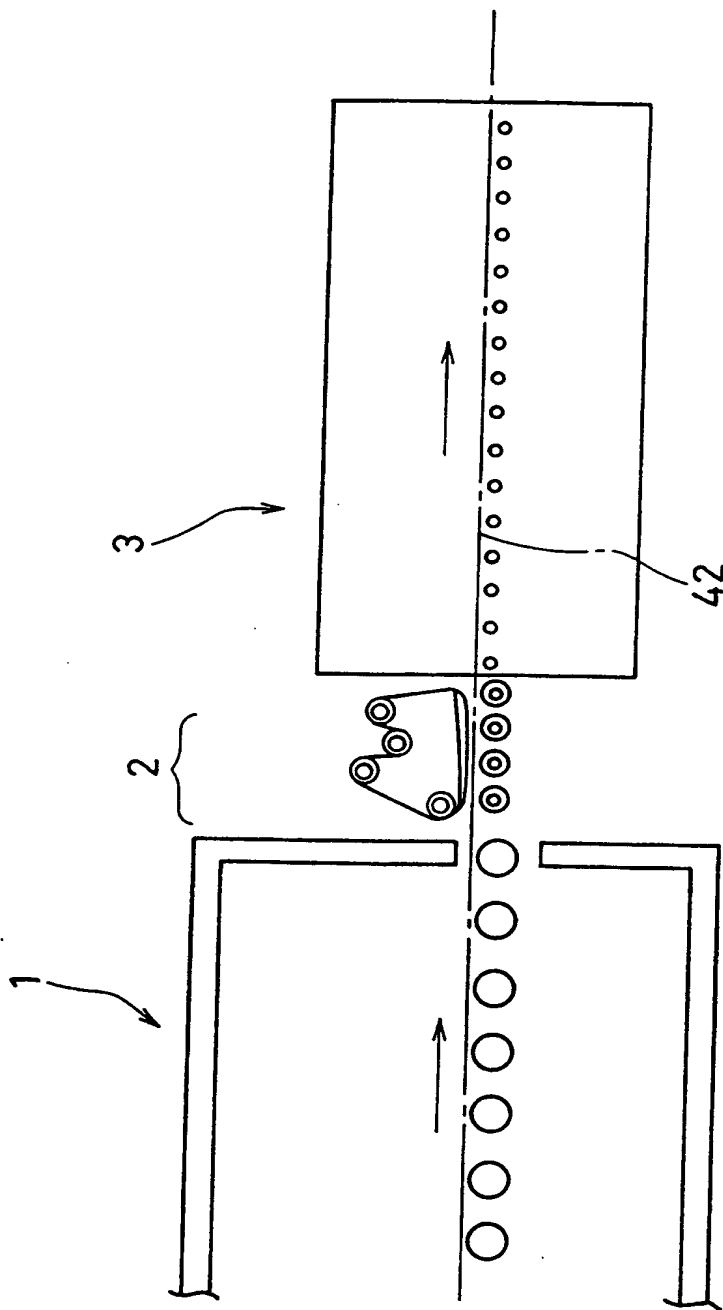


FIG. 15



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 99/06743

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 C03B23/033

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 C03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                     | Relevant to claim No. |
|------------|--|-----------------------|
| P, X       | WO 99 24373 A (NIPPON SHEET GLASS CO. LTD.)<br>20 May 1999 (1999-05-20)<br>the whole document          | 1-12                  |
| X          | US 3 545 951 A (NEDELEC)<br>8 December 1970 (1970-12-08)<br>figures 1,2                                | 1-12                  |
| X          | FR 2 137 143 A (SAINT-GOBAIN)<br>29 December 1972 (1972-12-29)<br>the whole document                   | 1-12                  |
| A          | DE 39 28 968 C (VEGLA VEREINIGTE GLASWERKE<br>GMBH) 17 January 1991 (1991-01-17)<br>the whole document | 1-12                  |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

29 February 2000

Date of mailing of the international search report

07/03/2000

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## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.

PCT/JP 99/06743

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---|---------------------|----------------------------|---------------------|
| WO 9924373                                | A | 20-05-1999          | AU 9762298 A               | 31-05-1999          |
| US 3545951                                | A | 08-12-1970          | BE 694790 A                | 28-08-1967          |
|   |   |                     | DE 1679961 A               | 23-03-1972          |
|   |   |                     | FR 92064 E                 |                     |
|   |   |                     | FR 1476785 A               | 26-06-1967          |
|   |   |                     | GB 1134775 A               |                     |
|   |   |                     | LU 53096 A                 | 01-09-1967          |
|   |   |                     | NL 6703042 A, B            | 04-09-1967          |
|   |   |                     | SE 329899 B                | 26-10-1970          |
|   |   |                     | ES 337724 A                | 01-03-1968          |
| FR 2137143                                | A | 29-12-1972          | AR 192445 A                | 21-02-1973          |
|   |   |                     | AU 4229772 A               | 22-11-1973          |
|   |   |                     | BE 783422 A                | 13-11-1972          |
|   |   |                     | CA 973712 A                | 02-09-1975          |
|   |   |                     | DE 2223575 A               | 30-11-1972          |
|   |   |                     | ES 402718 A                | 16-04-1975          |
|   |   |                     | GB 1366038 A               | 04-09-1974          |
|   |   |                     | IT 955515 B                | 29-09-1973          |
|   |   |                     | JP 53041690 B              | 06-11-1978          |
|   |   |                     | LU 65348 A                 | 22-01-1973          |
|   |   |                     | NL 7206307 A, B,           | 16-11-1972          |
|   |   |                     | SE 393593 B                | 16-05-1977          |
|   |   |                     | US 3832153 A               | 27-08-1974          |
|   |   |                     | ZA 7203243 A               | 28-02-1973          |
| DE 3928968                                | C | 17-01-1991          | DE 69004530 D              | 16-12-1993          |
|   |   |                     | DE 69004530 T              | 11-05-1994          |
|   |   |                     | EP 0415826 A               | 06-03-1991          |
|   |   |                     | ES 2048460 T               | 16-03-1994          |
|   |   |                     | FI 91389 B                 | 15-03-1994          |
|   |   |                     | US 5022907 A               | 11-06-1991          |